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On the Behavior of Young *Lobotes surinamensis*

By C. M. Breder, Jr.

THE alleged resemblance of young *Lobotes surinamensis* (Bloch) to dead leaves floating in the sea has been the subject of casual comment by a number of authors, such as Hildebrand and Schroeder (1928) and Beebe and Tee-Van (1928), while others have discussed the behavior of adults too large to be mistaken for the usual sizes of dead leaves encountered in their range (Gudger, 1931, and Baughman, 1941). Breder (1946) mentioned these items in connection with other matters associated with deceptive resemblances in fishes, without having had the opportunity to study at first hand the appearance and behavior of the species in question.

An opportunity to study these features of *Lobotes* presented itself in January, 1949, when a specimen was obtained at Bimini, B.W.I., and held in confinement at the Lerner Marine Laboratory located on that island. The details of the behavior of this individual are herewith discussed in connection with an extension of the consideration of such matters given in Breder (1946).

The Fish

The individual fish studied measured 90 mm. in total length and 35 mm. in depth, 45 mm. in depth including the erected dorsal fin. It was yellowish tan in color and marked with roundish black spots. About 15 such spots of various sizes and shapes were located in a central area on the sides, three on the dorsal base, posteriorly, one on the anal base and four on the frontal area of the head. The lobate portion of the dorsal and anal were narrowly edged with black and the caudal fin was less intensely edged. The ventral fins on which the body color extended were also black-edged along the first spine. A black line passing through the eye extended backward above and below, placing the eye at the base of a "V" pointing forward, the limbs of which extended nearly to the gill opening. This general pattern may be seen in the accompanying plate. The pectorals were completely hyaline and practically invisible. All the other fins were completely pigmented with the general body color.

At rest, the fish took up a position usually at or close to the surface on one side, sometimes parallel to the water surface but more frequently at a slight angle to it with the head down, as shown in Plate I. The whole fish was generally bent in a slight arc with the convex side uppermost. It could be easily passed over as a dead leaf.

Locomotion under such conditions was effected entirely by the transparent pectoral fins. It was slow and resembled remarkably the drifting of a leaf. On occasion, the fish would reverse its sides rapidly, rolling over on its long axis in a manner not unlike a floating leaf, turning over when some vagary of current upsets its equilibrium. When slightly disturbed, it would not dart off as is usual with fishes but would recede from the source of disturbance at only a slightly greater pace than when moving for other reasons.

If sufficiently disturbed, as by an attempt to catch it in a net, it confined itself to short darts of not more than 18 inches when it would immediately resume its posturing.

This individual was under observation from December 28, 1948, to January 15, 1949, when it was preserved. On death it immediately lost its tan coloration and the dark spots, and took on a mottled black and whitish appearance more usual in specimens of a larger size.

The Leaves

The leaves found in association with the habitat of this fish were mostly those of the red mangrove, *Rhizophora mangle*, with a scattering of the black mangrove, *Avicennia nitida*. These leaves varied from bright green new leaves through various shades of yellow and brown to nearly black. The more aging leaves tended to sink and disappear as a surface feature, being replaced by new leaves at the other end of the series. Many were unmarked but a number were spotted with black marks of various kinds and disposition.

A collection of 500 such leaves taken at random were measured as to various pertinent features, and the data are given in Table I and expressed graphically in Figure 1. The length and breadth measurements are simple and need no explanation, but the recording of coloration and spotting was of necessity somewhat arbitrary. However, it is entirely adequate for present purposes. While the leaves that showed black spots more or less resembled those on the fish, they were distributed with no apparent system and seemed entirely fortuituous. An occasional leaf showed a slash or a dark streak, but these were far too few to have any important bearing on the problem and are not included in the count of spots. All leaves seen in this sample were referable to either the red or the black mangrove, their specific differences accounting largely for the rather large range of the length-breadth ratio.

Discussion

It is evident from Table I and Figure 1 that the dimensions of the fish are within the range shown by the leaves, but that both its length and breadth are considerably above both the mean and the mode of the leaves. As the leaves that are shed retain a fairly constant average size, it follows that the fish must have passed the mode of the leaves some time back, perhaps about two months earlier. It would seem from general considerations that late last summer this fish would have been too small to enter into this complex of drift and is now well on the way to pass out of it. Since at this place the mangroves shed more leaves in the fall than at any other season, as is evidenced by their relative abundance on the surface, it would appear that this species passes the mode of their lengths and widths just about the time that the leaves are a conspicuous feature of the drift. It has been further noted that these mangrove trees present a brilliant green appearance and show few yellow leaves in the summer time whereas in the fall they show a distinctly yellowish appearance because of the relatively large number of dying or dead leaves still attached to the branches.

The approximate number of spots on the fish is also well above those of the leaves both as to mode and as to mean. Little can be said about this on the basis of a single individual. Not until statistical data on the fish equivalent to that here presented for the leaves are accumulated would further discussion of this point be warranted. The color which the fish approximates most closely is that class of leaves here designated as light brown, which happens to be the largest group.

TABLE I

DATA ON 500 MANGROVE LEAVES. MEASUREMENTS IN MM.

LENGTH	f	LENGTH	f	WIDTH	f	L/W	f		SPOTS	f
38	1	78	15	17	2	1.8	3		0	54
41	1	79	18	18	1	1.9	18		1	60
45	2	80	24	19	4	2.0	64		2	64
47	1	81	19	20	1	2.1	35		3	61
48	2	82	12	21	2	2.2	72		4	49
49	1	83	14	22	5	2.3	75		5	36
50	3	84	12	23	7	2.4	80		6	38
51	1	85	17	24	9	2.5	54		7	27
52	2	86	14	25	12	2.6	35		8	18
53	3	87	12	26	9	2.7	25		9	15
54	2	88	17	27	23	2.8	16		10	8
55	1	89	11	28	20	2.9	14		11	9
56	2	90	12	29	21	3.0	5		12	6
57	1	91	8	30	27	3.1	1		13	8
58	4	92	8	31	2	3.2	2		14	7
59	2	93	7	32	9	3.4	1		15	5
60	4	94	4	33	33				16	6
61	5	95	2	34	32	MEAN	2.34+		17	6
62	7	96	6	35	42				18	3
63	10	97	4	36	40	FISH	2.29[1]		19	2
64	7	98	2	37	25		2.00[2]		20	1
65	11	99	4	38	21				21	1
66	5	100	4	39	17				22	2
67	8	101	4	40	18	COLOR		f	23	1
68	7	102	1	41	22				24	2
69	18	103	1	42	7	Green		6	25	1
70	21	104	1	43	15	Greenish		1	26	2
71	16	106	2	44	7	G.-yellow		16	27	2
72	11	113	1	45	4	Yellow		57	28	1
73	13	119	1	46	6	Lt. brown		378	31	2
74	13			47	1	Dk. brown		38	33	1
75	25	MEAN	77.80	48	2	Red-brown		1	39	1
76	12			49	2	Red-purple		1		
77	22	FISH	90	62	1	Red-black		1	MEAN	5.42—
						Purp.-black		1		
				MEAN	30.72+				FISH	15
				FISH	35[1]					
					45[2]					

[1] Dorsal depressed.
[2] Dorsal erect.

Perhaps the most interesting feature of the resemblance of this fish to these leaves is to be found if the proportions of length to width of both fish

and leaves are considered. Absolute size alone is only one requirement of resemblance and not necessarily the most striking one. The proportion of

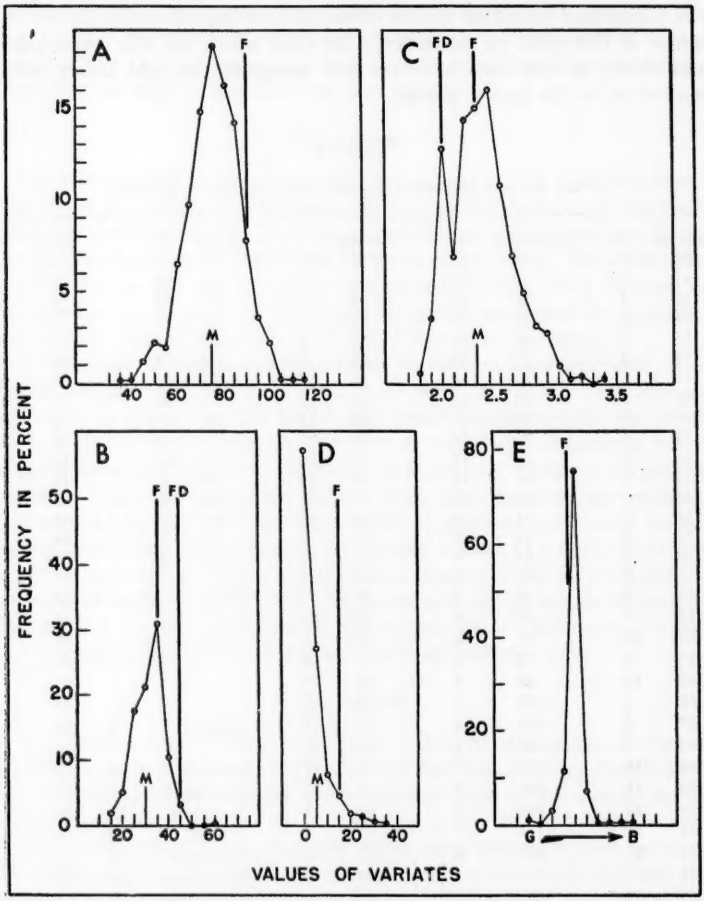
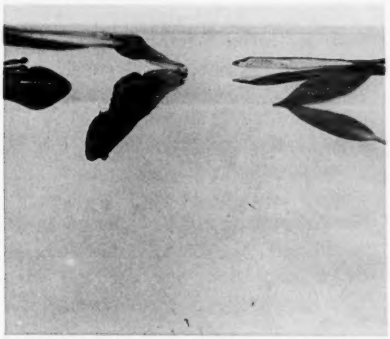


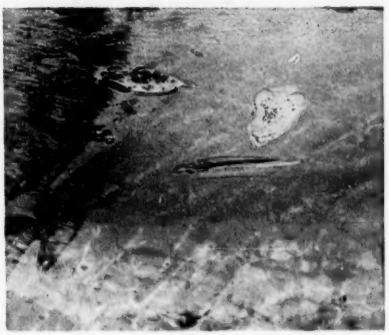
Fig. 1. Range of characters of mangrove leaf sample compared with those of a young *Lobotes*. A. Leaf length. B. Leaf width. C. Ratio of width to length, i.e. L/W. D. Number of black spots on leaves. E. Range of color variation with decay of leaves from Green to Purplish-black.

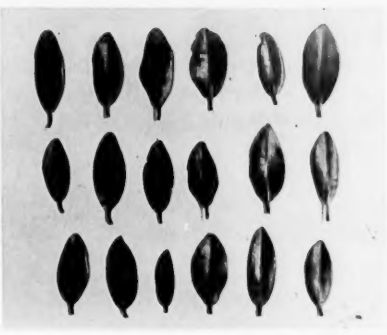
In each case the heavy vertical line marked F indicates the value for the fish. FD indicates the value with the dorsal fin erect. M indicates the location of the arithmetic mean.

All frequencies expressed in per cent of total. Classes of graph A, B and D are groups of five units, the values indicated being the initial value of its class. In graph C the indicated values are the mid-points of classes of ratios. See text for explanation of usage in graph E. All data calculated from Table I.

length to breadth may actually be more revealing or disguising under many circumstances. Graph C of Figure 1 shows this relationship and it develops







Upper right and left. Lateral views of fish posturing amid floating mangrove leaves, as seen in an aquarium.

Middle right and left. Dorsal views of fish posturing amid floating mangrove leaves, as seen in a large outdoor pool. The fish in each photograph is in the exact center.

Lower left. The fish retaining its pose as an *Atherina* swims past.

Lower right. Typical mangrove leaves taken from the sample discussed.

that two modes are present. This is another reflection of the fact that both red and black mangrove leaves made up this sample. The fish with its dorsal erect is close to one mode and with the dorsal depressed is close to the other. With this analysis it should be possible to determine whether the fish "regulates" its apparent width in reference to the leaves with which it is associated, a matter that might be made the subject of experimentation.

In addition to the resemblances already noted between fish and leaves is the reaction of the fish to the presence of leaves. When a handful of such leaves were tossed into the aquarium containing the fish it immediately moved toward them in its characteristic drifting type of locomotion and literally "schooled" with the leaves. The performance was most impressive as they were the only objects from which a positive reaction could be illicited.

On the other hand, the reaction to other fishes was to remain inert as indicated in the lower left hand photograph of Plate I, showing an *Atherina* swimming rapidly by, evidently unaware of the *Lobotes*. It paid no more attention to the fish than to the more numerous leaves.

The present case represents one more species of marine fish, which, during its growth stages, has a definite association with parts of mangrove trees. The recorded cases now stand as follows:

	Species	Association	Authority
1.	*Platax orbicularis* (Forskål)	leaf	Willey (1904)
2.	*Platax tiera* (Forskål)	leaf	Mortensen (1917)
3.	*Oligoplites saurus* (Bloch and Schneider)	leaf	Breder (1942)
4.	*Chaetodipterus faber* (Broussonet)	seed-pod	Breder (1946)
5.	*Lobotes surinamensis* (Bloch)	leaf	Present report

There are thus four species of fish which have been mistaken for mangrove leaves and one for its infertile seed-pods. It is only in the second case that the adult resembles a leaf, presumably that of the mangrove, whereas in all the others it is a young developmental stage which shows such resemblance. In the first two examples, both Pacific, it is the depth of the fish that corresponds to the length of the leaf, and in the last two, both Atlantic, it is the length of the fish that corresponds.

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The Names of the Higher Categories of Fishes

By WILLIAM A. GOSLINE

ALLOTRIOGNATHI, Ginglymodi, Hypostomides—these and other Greek names for fish orders to be found in the classifications of Regan and others have always been for me rather awe-inspiring if unintelligible. As an essential part of ichthyological training I learned them, and forgot the difficulties of the process. Today, as I in turn present these ordinal names to students, I receive back the same blank stares which once were my own.

Yet today the names of the higher categories of fishes present more problems than ever. The disagreement as to what fish orders should be recognized remains, but in addition the question of how their names should be formed has become acute. Berg, in 1940, formed the names of his higher categories from a set of stems and terminations different from those previously used. Schultz, in 1948, proposed a still different system. At present, not only are there several different sets of names for the same taxonomic levels, but the same name may be used by various authors for different taxonomic levels.

It would seem that there are enough disputed zoological problems in the higher fish categories without adding purely nomenclatorial ones. In fact, the very presence of these zoological differences of opinion makes it the more desirable that a simple, clear, and uniform system of nomenclature be used. The object of this paper is to present the problems involved in naming the higher fish categories and to suggest what seems to be the best solution to these difficulties.

If, as in the earlier days of ichthyology, most zoologists learned Greek and if the ordinal names of fishes were composed of compound Greek words descriptive of the fishes included, little difficulty would be experienced in associating such names with a group of fishes. But few of us today learn Greek, so that now these ordinal names must be learned and associated with a group of fishes largely by rote. If, also as in earlier days, only a few orders of fishes were recognized, no great hardship would be imposed upon the learning powers of the student by having an independent name for each order. But now as many as 114 orders of fish-like vertebrates are recognized

by a single author (Berg, 1940). Whether or not one chooses to recognize so many orders, one is nevertheless forced to be acquainted with a great many ordinal names to read the ichthyological literature of today. Thus, the old system of giving an independent Greek name to each order, felicitous as it may have been in the past, is now extremely burdensome. Nevertheless such recent authors as Romer (1945) and Pearse *et al* (1948) continue to use it.

Berg (1940) recognized this point. To avoid the necessity of learning a whole host of new names, he used the stem of the "most distributed and best known family" as the stem of his higher fish categories through order, using a different termination for each of the higher systematic levels. Under this system the same stem is used for everything from genus through order; only as many endings as there are categories between these levels must be learned in addition. The necessity of memorizing a different name for each superfamily, suborder, and order is eliminated. Also, because the termination for a name at any one systematic level is always the same, no ambiguity arises as to what taxonomic category is under discussion.[1]

There are further advantages to Berg's system. The same method of forming ordinal names is now in use in ornithology and seems to be well-received. In ichthyology there has been considerable systematizing of the naming of higher categories since the time of Goodrich (1909). This author (1909, 1930) used the stem of a generic name as the stem of many, though not all, of his tribes, divisions, and suborders. Jordan (1923) also formed many of his series and subordinal names from a generic stem. Regan (1913, 1929, and elsewhere) took generic stems as bases for the names of divisions and suborders. Berg merely carried this method of naming on to ordinal rank and applied it consistently to all systematic levels from subfamily through order. In doing so it seems to me that Berg is merely crystallizing a trend already well-established and well-justified in ichthyological literature. Berg's nomenclature also has the advantage of being readily available in English in a book originally printed in Russia, but recently (1947) lithoprinted in the United States. Furthermore, this book contains an adequate synonymy of names previously proposed for the higher categories of fishes. Consequently, if certain ichthyologists prefer to follow the older nomenclature *in toto* or in part for some time to come, no great harm is done; those who do not recognize these older names can look them up in Berg.

Schultz (in Schultz and Stern, 1948) did not follow Berg's terminology. He did, however, give uniform endings to his suborders and orders, "*oidea* for words with Greek roots, and *iformes* for words with Latin roots" (Schultz and Stern, 1948: 220). Thus both suborders and orders take the same ending, but a distinction is made according to the linguistic derivation of the root. The undesirable features of this system do not seem worth belaboring inasmuch as Schultz himself (personal correspondence) seriously considers abandoning it.

[1]However useful it may be to be able to speak of a group of fishes without specifying rank, it does not seem to me that it is the function of zoological nomenclature to provide terms for this purpose: by its very nature zoological nomenclature should be specific rather than general.

There are also valid objections to the system proposed by Berg. Though I feel that such objections are minor individually and in sum total do not counterbalance the advantages of the system, I do not wish to minimize them. Many of the older names, such as Ostariophysi, Isospondyli, and Heterosomata, are widely and deeply embedded in literature which ichthyologists will always have to consult. Perhaps exceptions for a few of these more time-honored and stable names could be made in Berg's system, though I myself believe such a procedure inadvisable.[2] Secondly, when the same stem is used for every level from genus through order, some difficulty arises in providing common names for the different categories. For example, "cyprinodont fishes" might constitute anything from a generic to an ordinal group. This problem seems easily enough remedied, except for literature already written; the family Cyprinodontidae could be called the cyprinodontids, the order, the cyprinodontiform fishes, etc. Another source of objection arises from the nature of the Rules of Nomenclature. It may be that some of the generic names upon which well-known family names are based will be found to be homonyms or synonyms. If this occurs, the name of the genus and family, and under Berg's system higher categories, would have to be changed. But I hope and believe that such instances will be rare. Furthermore, under any system of naming higher categories, the type genera of well-known family names should probably be placed among the *nomina conservanda* of the International Commission of Zoological Nomenclature; some of them, indeed, are already there. Perhaps a greater potential source of difficulty arises from the method of naming families. Although the International Commission is indefinite on this point, according to present usage a family takes the name first used for the group as a family or subfamily name which is based upon a valid genus of the group (Myers, 1943: 148). It may be that a different earlier family or subfamily name for some of our well-known families will be found. Under Berg's system this might necessitate a change in the name of higher categories in addition to that of the families themselves. However, I feel that dislocations of this sort would be rare, if only because the use of family names in ichthyology does not go back beyond the time of Louis Agassiz (see Gill, 1896: 25–27). The final serious objection to Berg's system that I know of lies in the actual set of terminations which Berg (1940: 353) used for the different categories. The termination *ini* for subfamilies is untenable under the International Code of Zoological Nomenclature, which specifically states that subfamilies must end in *inae*.[3] Berg's superfamily ending *oidae* is uncomfortably close to the family termination *idae*, and *oidei* for suborders is probably less well-known than the subordinal *oidea* of Regan and others. Even Berg's ordinal ending *iformes* is not entirely free from confusion, for Regan uses this same termination for division (equals superfamily).

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[2] It may be that paleontologists have good reasons not to follow Berg's system in fossil fish groups. But if this system were to fail of adoption in such groups I cannot see that any great harm would be done, though again I would prefer a uniform treatment throughout.

[3] Berg's reason for using the subfamily ending *ini* arises from an attempt to be classically correct (1932: 159); in this instance he feels that classical propriety is more important than adherence to the International Code. Personally I believe that zoological nomenclature is an international language and that its basis in Latin and Greek is an historical accident which should not be allowed to distort or encumber unduly the purpose which nomenclature is intended to accomplish.

It is not the object of the present paper to argue in favor of one set of terminations or another. But simply because Berg's endings are readily available and in use I should prefer to follow them, except for subfamily, until some general agreement is reached to do otherwise. Again, I do not wish to go into the advantages and disadvantages of applying a uniform system of nomenclature to the few names of fish categories higher than order.

Rather, the present plea, made chiefly in the interest of future ichthyological students, is written with two objectives. First, I should like to see eliminated the necessity of learning a separate Greek or Latin name for every order, suborder, and superfamily. It is probable that such ordinal names as Glaniostomi, Heteromi, Solenichthyes, Hyperoartia, Holconoti, Malacichthyes, Xenopterygii, Haplodoci and Opisthomi mean as little to most other ichthyologists as they do to me, and I see no reason for continuing to perpetrate such names on ichthyological students in the future. Second, I should like to see general agreement among ichthyologists on a single system of naming the higher fish categories. Since the system proposed by Berg does away with the necessity of learning a separate name for each order, etc., and since it seems to be the best for this purpose yet proposed, I should like to see it followed. Hence, the above plea in its behalf.

It is quite possible that I have omitted, misinterpreted, or underestimated some of the objections to Berg's system. If so I hope that the occasion will be taken to present such objections in order that a well-rounded discussion of the problems involved may be made available.

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Spontaneous Depigmentation in the Catfish *Ameiurus nebulosus*

By PRISCILLA RASQUIN

THE chromatophore systems of teleosts in general, and that of the freshwater catfish *Ameiurus nebulosus* (Le Sueur) in particular, have been widely studied. Parker (1948) published an extensive review of the subject. Odiorne (1937) used *Ameiurus nebulosus,* among other species of fish, to show that the degree of pigmentation is dependent upon the backgrounds on which they are kept. Melanophores are found in the dispersed condition when such fish are kept on dark backgrounds, and in the concentrated condition when they are kept on light backgrounds. Odiorne found that blinded catfish kept in the light became extremely dark owing to the accumulation of a dense layer of melanophores in the epidermis, and that keeping them in darkness somewhat reduced this pigmentation, although not to the extent of that observed in the fishes kept on white backgrounds. It has been noted by several investigators (Odiorne, 1937, Sumner and Wells, 1933, Osborn, 1941*a*, 1941*b*, Rasquin, 1946) that the numbers of melanophores are increased when fishes are kept in the dark phase, and decreased when they are kept in the light phase. However, Osborn (1941*b*) showed that experimental production

of melanophores cannot be obtained in the hypophysectomized *Ameiurus melas*, indicating that the melanophore-dispersing hormone of the pituitary must be present for normal development and maintenance of melanophores.

In late July of 1946, a brood of young catfish, *Ameiurus nebulosus*, approximately four to six weeks old, were collected in Mahwah, New Jersey, and brought into the laboratory where they were raised in 15-gallon tanks of standing water under normal conditions of daylight and darkness. As they increased in size, they were distributed through more tanks, so that by the end of two years, no tank contained more than five fish. Many of the fish did not survive and some developed abnormalities of the skeletal system; there was considerable variation in size but all were smaller than would have been expected under wild conditions.

The aquaria were provided with yellowish quartz sand and floating plants, and in such surroundings the fish maintained a medium gray coloration. In July of 1948, after two years of living in the laboratory, one fish was observed to have lost its gray coloration. The color of the body was a faint pink, showing the color of the blood through the skin. There was also a conspicuous silvery sheen. The eyes remained dark. The fish was apparently in good health, eating regularly and moving about as actively as any of its fellows. Two months later, another catfish in an adjacent tank was observed to be losing its coloration in a similar manner. The top figure in Plate I, photographed in December, 1948, shows the first-mentioned fish (in which the depigmentation had proceeded farther than in the second) together with one of normal coloration.

The light-colored fish were killed by severing the spinal cord immediately behind the head and a pigmented fish from each of the same tanks was killed in the same way. One light fish measured 113 mm. in total length and its dark tank mate measured 103 mm. in total length (Fig. 1). The other light fish measured 135 mm. in total length and its dark companion measured 129 mm. Pieces of skin were removed from the back of the fish, anterior to the dorsal fin, fixed in Bouin's fluid, sectioned at 10 microns, and stained with Harris' hematoxylin and eosin for demonstration of the melanophores. Whole mounts were made from pieces of skin removed from the dorsal surface of the head. The pituitaries, with adjacent parts of the brain, were dissected and fixed in Helly's fluid. The stain used was a modification of Dawson and Friedgood's technique (1938), kindly furnished by Dr. Henry W. Aplington, of Muhlenburg College, who had received this information in Dr. Dawson's laboratory. The modification included using Helly's fixation instead of the one originally recommended, preheating the azo-carmine solution for more than an hour before using, taking care not to use the azo-carmine solution for more than two groups of slides, and adding about 20 drops of the phosphotungstic acid solution to the aniline blue-orange G staining mixture. The azo-carmine used was azo-carmine G, obtained from the Hartman-Leddon Company of Philadelphia.

All four fish were dissected to ascertain the state of the gonads. These organs were small, and could not be found in gross dissection in the light fish pictured in Figure 1. The other three fish were females, and histological

sections stained with hematoxylin and eosin showed normal ovaries containing only unripe ova.

Figures 2, 3, 4, and 5 represent photomicrographs taken of whole mounts of skin removed from the heads of the pigmented and light catfishes shown in Figure 1. Figure 3 shows the dermal melanophores of the light fish, which are surprisingly numerous considering the overall whitish appearance of the fish in life. However, comparing this photograph with that of Figure 2, which represents the dermal melanophores of the pigmented catfish, a difference is readily seen in the numbers and granulation of the pigment cells. A clear area surrounds each melanophore in the light fish. In addition, the light fish has very few epidermal melanophores. Figure 4 is a photograph of the epidermal melanophores of the pigmented fish taken from the same piece of skin used in Figure 2. Figure 5 is a photograph of the same piece of skin of the white fish that was used for Figure 3 with the camera focused in the plane where the epidermal melanophores would be found, if they were present. From these photographs it can be seen that the light fish lacks the epidermal pigment cells, and the loss of this covering layer probably accounted for the appearance of the silvery sheen of the guanin layer. The deeper-lying dermal melanophores show in each picture as out-of-focus dark areas. Only one epidermal melanophore was seen in two large pieces of skin from the head of the light fish. One or two more were seen in sections of the skin of the dorsal region.

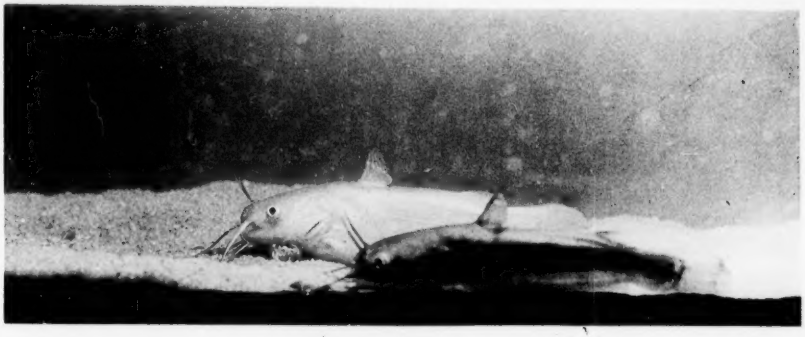
Since all the fish were killed in exactly the same manner, by severing the spinal cord immediately behind the head, and the pieces of skin removed and fixed immediately, there is no reason to suppose that the dermal melanophores of the pigmented fish are merely in a more dispersed condition than in the light fish.

The hypophyses of the light catfish appeared identical with those of the pigmented fish except that the pars intermedia of one light fish stained more deeply than the others, and under the low magnification gave the distinct appearance of basophilia. However, orange-staining acidophiles were seen to be abundant under higher magnification. The ramifications of the pars nervosa stood out more prominently, owing to the deeper staining reactions of the intermedia cells. It is not believed that any real histological difference is to be found in these two glands. The staining process is complicated, and differentiation of cells under the microscope during the staining process is done on each slide separately. Irregularities in the depth of staining are almost inevitable, since the cells being differentiated are seen accurately only under an oil immersion lens.

PLATE I

Depigmentation in *Ameiurus nebulosus*

Fig. 1. Photograph of normal and depigmented fish. **Fig. 2.** Dermal melanophores of normal fish, × 110. **Fig. 3.** Dermal melanophores of depigmented fish, × 110. **Fig. 4.** Epidermal melanophores of normal fish, × 110. **Fig. 5.** Plane of the epidermal melanophores of depigmented fish showing absence of pigment cells, × 110. **Fig. 6.** Section of skin from the dorsal region of normal fish, × 110. **Fig. 7.** Section of skin from the dorsal region of depigmented fish, × 110.



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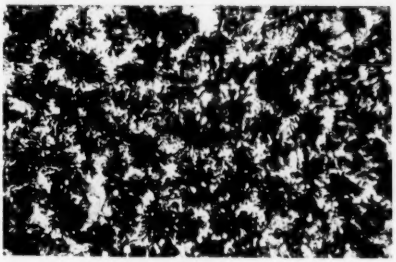

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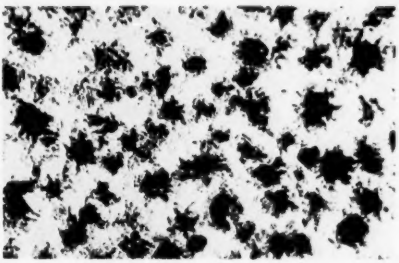

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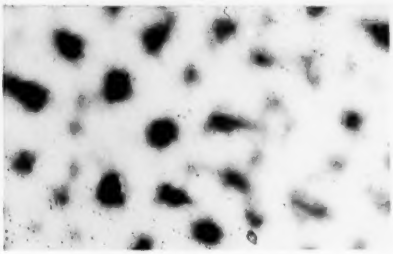

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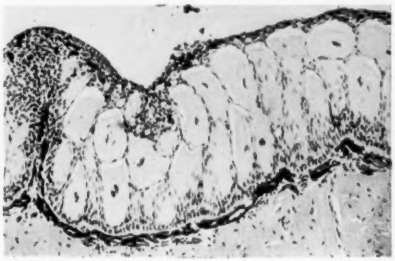

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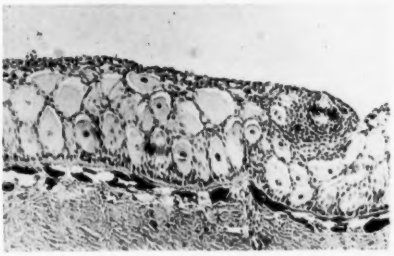

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Scruggs (1939) has described the histology of the hypophysis of ***Ameiurus nebulosus,*** and the appearance of the pituitaries of these specimens agrees with his description with a few minor exceptions. The pars anterior is made up chiefly of finely granulated cells which appear chromophobic or very faintly stained with carmine. Instead of the few scattered orange cells described by Scruggs, however, there are a large number of these cells whose cytoplasm appears nearly homogeneous. They are found grouped about the blood vessels and the lateral branches of the pars nervosa that enter this part of the gland. They do not stain a clear orange, but appear muddy in contrast to the orange acidophiles of other parts of the pituitary.

The pars transitional, or "übergangsteil," is the most brilliantly staining portion of the gland. Deeply staining acidophiles and basophiles are intermixed. Contrary to Scruggs' description, the acidophiles are not all carmine stained, but are colored either with carmine or with orange G. Basophiles are a deep blue. Some of the basophiles contain blue-staining granules of equal size and a lesser but still conspicuous number contain large, irregularly sized and shaped carmine staining bodies. These carmine bodies are so large that one can hardly term them granules, and are clearly contained within the confines of the basophile cells. The cell boundaries are clearly defined, and clear blue cytoplasm can be seen surrounding the carmine-staining bodies. Chromophobic cells are also found in this part of the gland and these are either colorless or faintly basophilic.

The pars intermedia is the largest of the subdivisions of the gland. The cells are so faintly staining that this portion of the gland sometimes appears chromophobic under low magnification. Under an oil immersion lens, the cells can be seen as either weakly acidophilic or basophilic. The acidophiles are stained with the orange G. The cells are fairly large, but not so great in size as those of the pars transitional. Occasional deeply staining basophiles of irregular shape are seen. The pars intermedia also contains large droplets or "Herring bodies" which stain brilliantly with the carmine. These are also seen in the pars nervosa.

No abnormalities were seen in the hypophyses of the light catfish. No differences from the normally pigmented fish were demonstrated in the pars intermedia of the light catfish that would lead one to suppose that the pituitary of the light fish was producing an insufficient amount of melanophore-dispersing hormone.

Discussion

Since Osborn's experiments (1941*b*) indicated that the melanophore-dispersing hormone of the pituitary must be present for the normal maintenance of melanophores, it was thought advisable to study the pituitaries of normally pigmented catfish as well as those of the light catfish, with particular reference to the pars intermedia. It must be understood that these were captive animals, living in comparatively cramped quarters for more than two years, and that abnormalities of growth and sexual development had made their appearance among other individuals of the same group. Scruggs (1939) did not mention whether or not his catfish were captive

specimens, but it is noteworthy that the histological picture of the hypophysis presented here does not agree in every particular with that described by him, although care was taken to use the same method of staining.

According to Odiorne (1948) ". . . any condition in the organism which brings about aggregation of pigment in the melanophores will, if maintained, inhibit or retard the further development of melanophores or even bring about the destruction of some of those already present." Conditions which bring about the concentration of melanin granules in the chromatophores and the subsequent decrease in numbers of melanophores are well known. These include keeping fish in darkness, keeping them on light or white backgrounds, and depriving them of the hormone of the pars intermedia by hypophysectomy. Even blinded catfish that exhibit a great increase in melanin when kept in the light lose much of their pigmentation when hypophysectomized (Osborn, 1941). Excessive pigmentation began to disappear from a catfish after previous blinding, when the fish was kept in the dark for only 23 days (Odiorne, 1937).

The change in coloration from the normal gray appearance maintained by these fish to the whitish, translucent coloration of the catfish described in this report, was obviously caused by a process of depigmentation. This is clearly shown by the photographs of dermal and epidermal melanophores of the two fish. Both physiological and morphological changes have occurred. All fish were raised under identical conditions, none was subjected to darkness, and although the sand at the bottom of the tanks in which they were kept was light in color, it is significant that only two fish underwent this depigmentation process. A histological study of the pituitaries of these fish, particularly of the intermediate lobes, showed no differences that would account for the loss of melanin in the depigmented animals. Therefore another factor, possibly genetic in origin, must be responsible for this condition.

The common goldfish, *Carassius auratus* (Linnaeus), is a familiar example of a fish which starts life having a gray coloration that changes as the animal becomes mature, according to the genetic constitution of each individual. The final coloration exhibited by the goldfish is primarily caused by the destruction of melanophores (Fukui, 1927). Goodrich (1935) showed that the destructive process was limited to certain periods in the life history of each individual. He also showed that the bold-striped pattern of *Brachydanio rerio* (Hamilton–Buchanan) was caused by the relatively small numbers of melanophores in the light regions that later disintegrated and thus accentuated the pattern. The delayed appearance of genetic characters may account for the aberrant coloration of these two catfish.

The absence of such light colored fish in the local waters from which this brood was collected evidently results from the fact that their conspicuous coloration makes them easy prey for any predator.

Summary

1. Two catfish, *Ameiurus nebulosus*, raised from an early age in the laboratory, showed a distinct whitish coloration after living in captivity for more than two years.

2. The aberrant coloration resulted from a loss in the number and granulation of the dermal melanophores and an almost complete loss of epidermal melanophores.

3. A study of the pituitaries showed no pathology of the pars intermedia of the white fish as compared with those of comparable pigmented animals, and no histological differences were observed in other parts of the glands.

4. The depigmentation process is therefore probably genetically controlled. The absence of such animals in a natural habitat evidently results from the fact that their conspicuous coloration makes them an easy prey for any predator.

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Reproductive Behavior and Development of Eggs of the Three-spined Stickleback *(Gasterosteus aculeatus)* of California[1]

By Ved Vrat[2]

ALTHOUGH the three-spined stickleback, *Gasterosteus aculeatus* Linnaeus, has been the subject of a large amount of work, many features of its biology are still unknown. Great variations in structure, correlated with its very wide distribution and its occupation of highly varied ecological niches, are matched by similar variations in habits and behavior. It was therefore thought advisable to present notes on the breeding activities of the species in California and to report upon the gross embryology and the larval stages in greater detail than was done by Kuntz and Radcliffe (1917).

Spawning Season

Various authors have noted the period of sexual activity in sticklebacks as spring. Bertin (1925) remarks that the spawning season is a function of temperature and varies with the latitude of the place concerned.

According to Bertin it varies as follows:

Region	Latitude in °	Spawning Period
Greenland and Scandinavia	60–70	June–July
Southern Scandinavia and Denmark	55–60	June
British Isles and Northern Germany	50–55	May and June
Germany, Austria, Belgium and France	43–50	April and May
Italy and Spain	35–43	March and April (?)

My observations were made and material collected in Carmel River and Dumbarton Slough, localities which fall between 36° and 38° N. Latitude. Spawning takes place in these localities from the first week in March to the end of July or even longer, a period of over five months and therefore for much longer duration than in Europe. In material collected at monthly intervals for age and growth studies I have encountered young sticklebacks less than 18 mm. in standard length, and presumably very young, in the months of March, April, May, June and July; also, the female adults were found to be full of eggs in these months. From data collected at Waddell Creek in the years 1935 to 1941 by the California State Division of Fish and Game, and kindly submitted to me for study, it is clear that the first indication of bright sexual coloration of males and the maturation of eggs in females takes place during the last week of February. At the Sloughs near Dumbarton Bridge, four males with bright blue-green eyes were seen by me

[1] It is a pleasure to express my appreciation to Dr. R. L. Bolin for his interest and guidance in my studies on the biology of sticklebacks, of which this work forms part, and to the Government of India Education Department for the grant of the fellowship which made it possible.

[2] Government of India Research Scholar in Fisheries.

making nests as early as February 13, 1947. Two specimens caught in the Salinas River in August, 1946, contained mature eggs. It is, therefore, clear that the period of sexual activity in the sticklebacks of central California lasts from February or March to the middle of August.

Bertin (1925) has suggested that the higher the temperature the earlier does the spawning season occur. Unfortunately I did not keep regular temperature records throughout the year but did make observations in April, May, June and July of 1947. The range of temperature in the Carmel River varied during these months from 15.8° to 18.5° C. Differences of temperature in aquaria in which eggs are developing do produce a difference in the time of development. However, it is difficult to predict the effect of temperature on the time of spawning with the degree of accuracy which Bertin has suggested.

Secondary Sexual Characters during Spawning Time.—Titschack (1923) has described fully the secondary sexual characters of the three-spined stickleback and Wunder (1930) has also made a good study of the coloration of the males. The only point which I wish to add to previous reports on the secondary sexual characters is that the first externally detectable change that occurs in a sexually ripe male during the spawning season is the appearance of a highly irridescent blue-green coloration in the iris of the eye causing it to shine in a characteristic and striking fashion. The body coloration then turns blue and, finally, the throat, the ventral surfaces of the body and even the flanks turn red in color. The bright body coloration may be quickly lost while attempts are being made to capture the fish but the coloration in the eye is one character that persists until the eggs are hatched and the young ones set out on their own. No color change was apparent in the females.

Nest Building.—Several nests were observed while they were being built by the males. The actions of the California sticklebacks in building these nests varied widely from the actions of European specimens, as reported by Wunder (1930) and others. No leaves, twigs or algae were ever used as building material in any of the nests observed. The male, after having chosen the site in a sheltered spot near the roots of some water plant or at the side of an aquarium, excavates the sand to create a hole 1½ inches to 2 inches long. This is accomplished by repeated strokes of the head and by taking mud or sand in the mouth and spitting it out to the side. The fish keeps coming out of the hole, tail end first, and touches the edges of the excavation repeatedly to ensure that they have not collapsed. All manipulation was done by striking against the walls and entrance of the nest with the head and mouth. Periodically, the male would stop work in order to make an inspection from all possible angles. The walls and the mouth of the nest are cemented so firmly that I was led to seek the source of cementing material. An examination of the buccal cavity during the process of making a nest revealed a considerable amount of sticky mucus which cements and holds the sand grains of the nest together. This secretion was absent in the males not in color and not building nests.

No male was ever seen even to attempt to use pieces of algae or small soft twigs in the construction although these were supplied in the aquaria and were abundant in the natural environment. The nests in natural streams

are always made towards the banks in very shallow water and are extremely inconspicuous when finished. They can be detected only by the presence of an attending male standing guard directly over the nest or in the immediate vicinity.

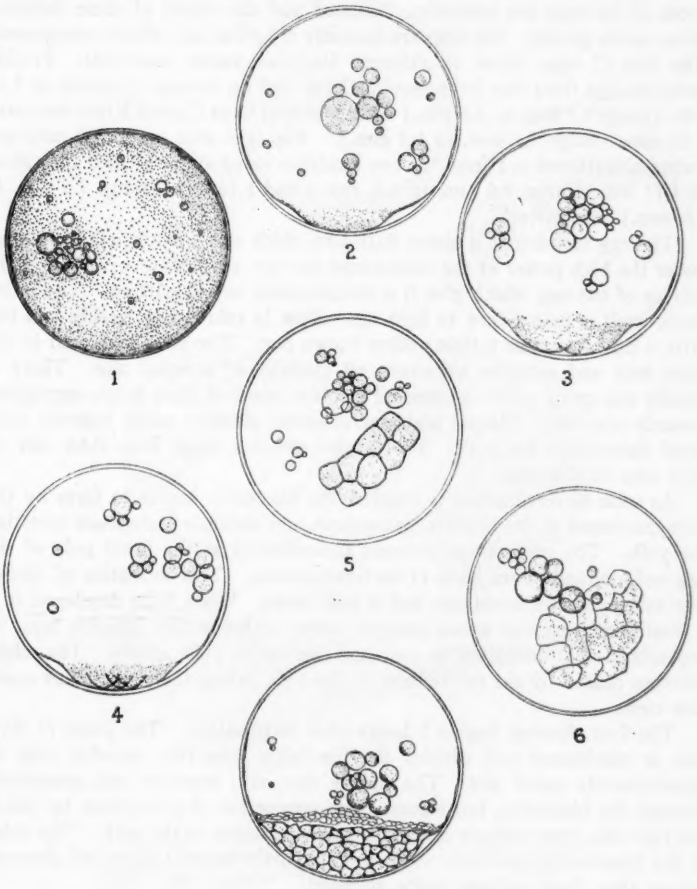
When the nest is completed, which usually takes 1½ to 4 hours, the male starts chasing females and finally succeeds in getting one into the nest. After a period of from 5 to 7 minutes spent in depositing eggs, the female emerges by making another opening opposite the entrance. Any attempts to back out through the same hole as she entered are repelled by the attending male. In two out of ten spawnings observed the male, soon after the female had emerged, entered the nest and sprayed the eggs with milt, which could be seen as a thin whitish fluid streaming out of the hole of entry. Shortly thereafter, he tried to get other females to deposit additional eggs. The second female that enters may come out of the nest by the hole created by the emergence of the first female or she may make another new exit. In the other eight spawning cases, however, after the first female emerged subsequent to depositing the eggs, the male chased her away and after about 10 minutes of coercion forced another female to enter the nest by striking her occasionally with his head and mouth. Only after the second female had emerged did he enter to fertilize the eggs. In one nest three different batches were found, which suggests that even three females may be led to enter the nest and lay eggs.

In all cases, after a period of usually one day, the male closes the hole or holes made by the females and starts to keep a watch on the hole of entry, fanning water into the nest with his pectoral fins. In one nest observed the male even closed the hole of entry after 3 days and dug it out again just before the time of hatching. The male guards the nest even when teased with twigs, which he fiercely attacks. All intruders are frightened away and he shows annoyance on slightest disturbance in the area.

Development.—The material used in this work was obtained both by taking naturally fertilized eggs from the nests and by stripping the ripe females. In fertilizing the eggs secured by the latter method it was necessary to macerate the testes of the male in the water into which the eggs had been stripped. The milt was then distributed over the eggs by means of a camel hair brush. After 5 minutes the ova were removed from the sperm suspension and put in fresh water at 17° C. and maintained at this temperature (with a maximum fluctuation of 0.6°) during the entire period of development. The water was kept free from contamination and changed frequently during incubation. The eggs were examined microscopically at frequent intervals and sketches were made by means of camera lucida.

It was observed that from 7.1 per cent to 10.0 per cent (average 8.5 per cent) of the eggs did not develop as a result of polyspermy. A small percentage, 1.4 to 3.2 (2.3 per cent average) failed to be fertilized. As a check on the normalcy of development, naturally fertilized eggs were also secured and kept under the same temperature and water conditions. It was observed that the incidence of polyspermy in naturally fertilized eggs is very small, being only 1.6 per cent to 2.4 per cent (average 2 per cent) and only a single egg of 193 examined was unfertilized.

Observations were also made on the development of eggs in water from San Francisco Bay. For this end, four females and two males taken in San Francisquito Creek were gradually brought through increasing salinity to



FIGS. 1-7. STAGES IN THE DEVELOPMENT OF THE EGG OF *Gasterosteus aculeatus*

1.—Mature unfertilized egg. 2.—Fertilized egg with fully developed blastodisc. 3.—Egg with blastoderm of two cells. 4.—Egg with blastoderm of four cells. 5.—Egg with blastoderm of eight cells (lateral view). 6.—Egg with blastoderm of 16 cells. 7.—Egg with blastoderm in advanced stage of cleavage, periblast differentiated.

marine water. After the specimens had been kept in salt water for fifteen days the eggs were stripped from the females and the testes from the males were macerated in marine water and fertilization effected. Only about 52 per cent of the eggs could thus be fertilized. The development of these eggs,

which were maintained in marine water at a temperature of 17° C. (with a variation of 0.7° C.), was then studied.

The eggs of *Gasterosteus aculeatus* are demersal and are laid in clusters adhering firmly to each other but not to foreign objects. The adjacent surfaces of the eggs are somewhat flattened and the extent of these flattened areas varies greatly. The eggs are basically spherical and almost transparent. The size of eggs taken in different localities varies somewhat. Freshly stripped eggs from San Francisquito Creek had an average diameter of 1.30 mm. (range 1.2 mm. to 1.6 mm.) while material from Carmel River measured 1.36 mm. (range 1.1 mm. to 1.5 mm.). The eggs soon swell and measurements of fertilized ova from the two localities listed above yielded the values of 1.71 mm. (range 1.6 mm. to 1.8. mm.) and 1.73 mm. (range 1.5 mm. to 1.9 mm.) respectively.

The egg membrane is about 0.03 mm. thick and quite smooth although under the high power of the microscope one can see minute wrinkles on the surface of the egg, which give it a characteristic netted pattern. The membrane itself is pale yellow to light tan yellow in color when freshly laid but after a time it attains a light yellow brown hue. The yolk is colored in the same way and contains numerous oil globules of unequal size. There is usually one group of 25 or more oil globules, some of them large, aggregated towards one side. Minute and medium-sized globules occur sparsely scattered throughout the yolk. The largest globules range from 0.66 mm. to 0.73 mm. in diameter.

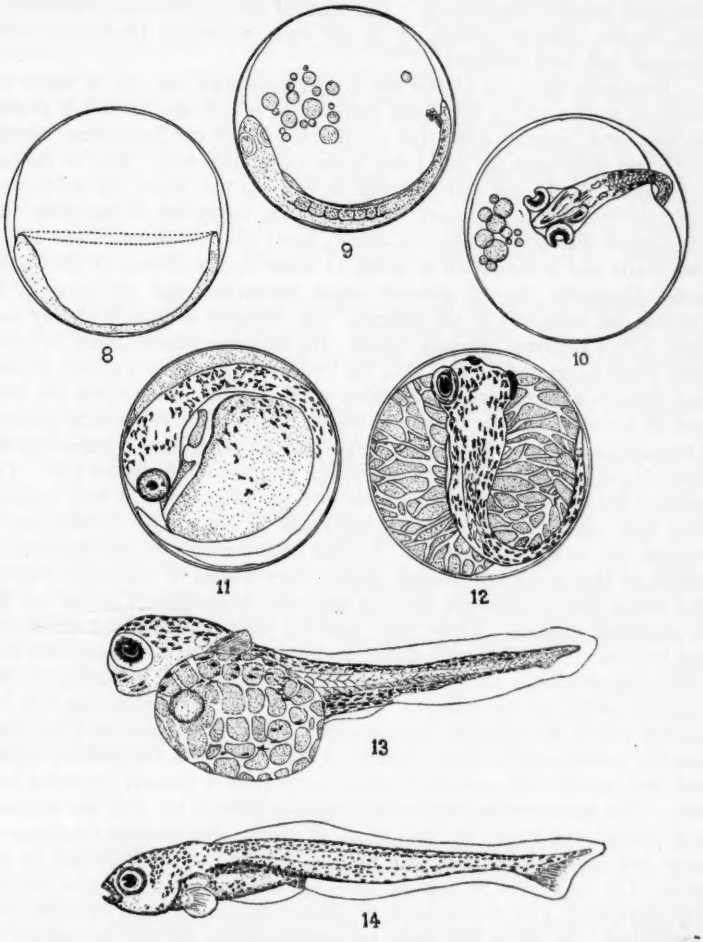
As soon as fertilization is effected the blastodisc begins to form by the slow movement of the hitherto transparent and invisible protoplasm investing the yolk. The protoplasm becomes concentrated at the lower pole of the egg and gradually loses some of its transparency. This formation of blastodisc takes place in about one and a half hours. When fully developed it is a small lenticular cap whose margins merge with the thin invisible layer of protoplasm that continues to surround the entire yolk sphere. The slight pressure caused by the protoplasm on the yolk brings the perivitelline space into view.

The first cleavage begins 3 hours after fertilization. The plane of division is meridional and divides the blastodisc into two rounded cells of approximately equal size. The furrow does not, however, cut completely through the blastodisc, but leaves a thin connection of protoplasm by which the two cells communicate at their surfaces adjacent to the yolk. The sides of the blastomeres gradually steepen and shortly before the second cleavage occurs they have become quite rounded.

The second cleavage takes place one hour after the first. This is also meridional, and at right angles to the first cleavage furrow, resulting in a four-celled blastoderm. About 40 minutes later the third cleavage furrows appear simultaneously on either side of the first plane of cleavage. The resulting eight cells are, therefore, arranged in two series of four cells each. The developing eggs show variations from the strictly regular symmetry but the cells in the blastoderm are fairly compact and rounded.

The next division is completed about 35 minutes later through the formation of two furrows, on either side of and parallel to the second plane of

cleavage. None of these divisions have completely cut through the blastodisc and therefore a continuous layer of protoplasm remains investing the



FIGS. 8-14. STAGES IN THE DEVELOPMENT OF *Gasterosteus aculeatus*

8.—Egg showing advanced stage in differentiation of embryonic axis and the germ ring. 9.—Egg with advanced embryo with six somites, blastopore closed with Kupfer's vesicle well developed. 10.—Egg with advanced embryo showing otoliths, pigments and divisions of brain. 11.—Egg with advanced embryo about 70 hours after fertilization. 12.—Egg with larva 4 days old. 13.—Newly hatched larval fish (actual standard length 4.71 mm.). 14.—Larval fish 6 days after hatching (actual standard length 7.2 mm.).

yolk at the bases of blastomeres. This protoplasm is the central periblast which later separates the segmentation cavity from the yolk. The succeeding cleavages are difficult to follow and cannot be described with accuracy.

The planes are simultaneously meridional and horizontal. The ultimate result is that 9 hours and 40 minutes after fertilization, a many-celled stage is obtained and the blastoderm now appears as a large cap consisting of numerous small rounded blastomeres. The edges of this multicellular blastodermic cap become sharply defined as in the fully developed blastodisc before cleavage had been initiated.

Two hours later the blastocoele is well developed and can be made out easily in section and in the living embryo. As it enlarges, its roof is pushed outward and becomes thin. The peripheral area of the blastoderm remains thick and rests upon the yolk; this is the early germ ring. Due to increasing opacity of the egg and a change in color to dull white the subsequent development of the embryonic shield and the migration of the germ ring are slightly difficult to make out, but 13 hours after fertilization this migration starts and is completed in about 12 hours by the closure of the blastopore. Gradually the oil globules orient themselves and all come to lie towards the head end of the embryo. The elongate embryo is clearly outlined with a thickened cephalic region. The blastopore closes about 24 hours after fertilization and by that time the embryo becomes more clearly defined and displays a more marked thickening at the anterior end. About one hour and 20 minutes after the closure of the blastopore Kupffer's vesicle appears. The embryo continues to grow in length and 30 hours after fertilization the eyes are outlined and Kupffer's vesicle has attained its maximum size. The embryo has now six pairs of somites and the heart may be seen beating. New body segments are added gradually and 38 hours after fertilization 12 somites can be counted readily. By this time the embryo has increased in length so that it extends around almost three-fourths of the yolk. Thirty-five hours after fertilization the first scattered melanophores appear on the dorso-lateral surfaces. Three hours later the pigmentation of the dorsal side has become accentuated with numerous black and brown melanophores and yellow xanthophores and at the same time the color is spreading to the cephalic portion of the embryo. The eyes, in which the pupils are now becoming visible, also develop pigmentation. Fifty-seven hours after fertilization the otoliths appear and guanophores soon develop in the auditory region and then spread both anteriorly and posteriorly in a sparsely scattered pattern. The pigmentation on the head and the sides of the yolk sac becomes well defined and heavy by the end of 59 hours. The embryo continues to grow and by this time its length slightly exceeds the circumference of the yolk. The brain with its various lobes can be easily seen, the eyes become well developed, and the network of circulation on the yolk becomes well established. By 83 to 107 hours the embryo shows the first movement by twitching the tail. On examination under subdued or red light the fin-fold can also be seen and the notochord made out. Further changes are few and slow. The embryo continues to grow and become stouter and the pigmentation assumes a characteristic pattern. The movements soon become frequent and violent and often the embryo rolls completely over in the egg membrane. By 140 hours the embryo is fully formed and ready to hatch. Frequent violent movements and apparent attempts to straighten the tail finally result in rupture of the shell. Normally the head emerges first and

hatching is usually completed in about 20 minutes. Sometimes the tail end emerges first, and when this occurred the embryo almost always died before coming completely out of the shell.

The newly hatched larva swims actively with rapid beating of the tail and vibrations of its small pectoral fins. After swimming around for about a minute it settles down to the bottom exhausted, only to repeat the active movements after a brief interval. During the first 2 hours after hatching the larva alternately swims and settles down, rolling over on its side, due to the protuberant yolk sac. After a short time however, it becomes able to maintain an upright position when at rest. The larvae on hatching measure 4.71 mm. to 4.91 mm. in standard length. Those hatched from eggs taken in Carmel River average about 0.2 mm. larger than those from San Francisquito Creek, while the larvae from California exceed by 0.5 mm. (average) the length of Kuntz and Radcliffe's material from Woods Hole, Massachusetts.

Immediately after hatching the body axis of the larva is slightly curved but it soon straightens out except in the cranial region. The position of the mouth is marked by a slight depression as yet closed. The eyes are large and the otoliths can still be seen. The colorless and transparent fin-fold arises dorsally about over the middle of the yolk sac and extends continuously around the body, terminating at the anus.

The pectoral fins are fan like and maintain their beating even when the larva is at rest. The trunk is thickly covered with melanophores and yellow xanthophores as well as guanophores. The flanks of the yolk sac are also covered with yellow pigments. Seven days after hatching the yolk sac is completely absorbed and the head becomes sharply defined. The mouth is well established and the larva starts feeding on Paramaecium and other Protozoa. The pigmentation acquires a definite pattern and bands of brown pigments appear behind the head. The general color of the body presents a darker shade than in earlier stages. The pigmentation is very sparse on the ventral surface. The larva grows rather rapidly in length and in about 30 days after hatching becomes a miniature stickleback in all details except the lateral plates, which appear after 2 months.

Observations in Marine Water

The development of these fish in confinement appeared to be perfectly normal in all respects and the mortality was very low. However, this was not the case with the larvae reared in salt water. Not only was the percentage of fertilization small but both eggs and larvae showed a high mortality rate. By the end of 86 days all the young fishes in salt water had died. The maximum size attained by these fishes was only 16.4 mm. average, while those raised in fresh water averaged 19.9 mm. at the end of 86 days. It is clear from these facts that either the sticklebacks do not spawn in the sea itself or have a terrific mortality in that environment. No nests could possibly be observed in San Francisco or Monterey Bay although there were nests in the slough near Dumbarton Bridge, East Palo Alto, where the salinity is fairly high.

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Effect of Food and Environment on Growth of the Fish *Ophiocephalus striatus* in Aquaria

By A. K. DAS

FISHES, like human beings, need air to breathe, healthy surroundings, and a wholesome diet. The object of the present investigation was to determine how far food and habitat can co-operate to promote maximum growth in the early life of fish in aquaria.

EXPERIMENT

Three aquaria were used, two of the same size with a capacity of about 10 gallons each, and the third, a smaller one with a capacity of 1 gallon. All of them were filled with potable water. Into each of the aquaria were introduced one dozen murrel (*Ophiocephalus striatus* Bloch) fingerlings about one month old, from the same brood. The collective weight of a dozen of the fingerlings was found to be approximately 20 grammes.

The three aquaria were kept at room temperature and were labelled A, B, and C (C being the smaller one). The fishes in A were fed with white wheat flour autoclaved at 10 pounds pressure for half an hour, and those in B were fed with white flour plus proteolysed liver powder (Prohepex[1]) on 50:50

[1] Prohepex is a product of T.C.F. Ltd., Bombay. It contains all the active principles of whole liver.

basis. The fish in aquarium C were given the same diet as prescribed for the inmates of A.

The diet was introduced to these fishes in the form of minute pills, with a pellicle of groundnut oil around each pill. The oil was supposed to be free from all known vitamins, and was intended to insulate the food particles present in each pill against their immediate dispersal in water.

Several pills of food were offered to these fingerlings once a day in the afternoon, and the water of the aquaria changed every morning. Whatever uneaten fragments were left were siphoned off by means of a rubber tubing before the next change of water to avoid pollution of the water by the decomposition of food. Records were kept of the weekly weighings of the individual lots of fingerlings. The growth data are presented in Table I and Figure 1.

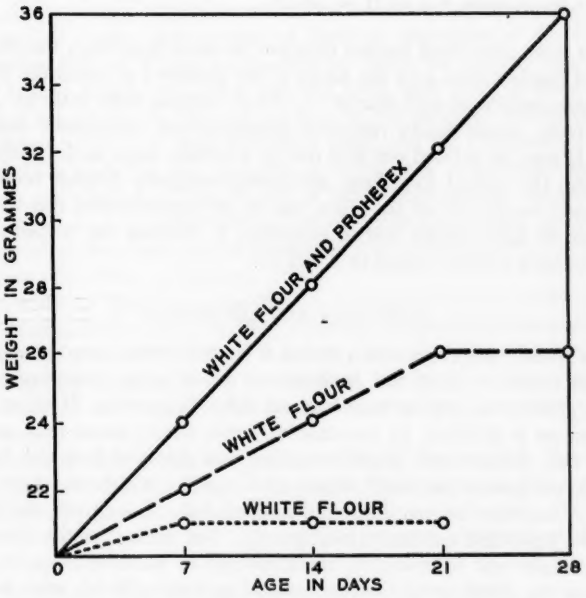

Fig. 1. Growth curves for the experimental fish in three aquaria. For explanation, see Table I.

Observation

A glance at Table I shows the remarkable difference in weekly growth exhibited by the fingerlings in the three aquaria. The batch belonging to aquarium B displayed the maximum growth, attaining 36 grammes by the end of the fourth week; whilst the members of aquarium C registered the minimum growth of 21 grammes up to the end of the third week, and all

except three of them died before the end of the fourth week. Those of aquarium A took an intermediate position as regards growth, reaching a maximum of only 26 grammes at the end of the fourth week.

TABLE I

WEEKLY GROWTH RECORDS OF THE EXPERIMENTAL FISH

The figures are the approximate collective weight in grammes of the 12 fish in each experiment.

Date, 1947	Aquarium A; fed white flour	Aquarium B; fed white flour and prohepex	Aquarium C; fed white flour
Sept. 1	20	20	20
Sept. 7	22	24	21
Sept. 14	24	28	21
Sept. 21	26	32	21
Sept. 28	26	36	*

* No data on weight; 9 of the 12 fish had died.

The most interesting feature observed of these fingerlings was the blackening of pigmentation over the backs of the members of aquarium B (which is a characteristic of wild murrel) in sharp contrast with those of A and C respectively, whose backs remained greyish-brown throughout the experiment. It may be pointed out here that at a certain stage in the early part of their life, the murrel fingerlings are characteristically greyish brown. Also their body is striated on the sides, and in the experimental fish the stripes appeared to take a black hue in aquarium B, whereas the stripes remained greyish-brown in those reared in A and C.

DISCUSSION AND CONCLUSION

The weekly weighings over a period of several weeks demonstrated clearly that the factors of food and environment are of prime importance in promoting growth and general health of the fishes in aquaria. If either food or environment is deficient, its resultant deterrent effects are at once noticeable on the fish. Such a poor growth response was obtained from the fish in A. The poorest growth was in C, where all except a few fish succumbed to the effects of malnutrition and congested environment. In contrast, the fish in B showed a rapid and uniform rate of growth. The reason for the difference in growth might well be traced to the difference in nutritional quality of the food, and the condition of the environment to which the fish were subjected. The autoclaved white flour, which was fed to the fish in aquarium A, has a protein value of only 11.2 per cent and the vitamin B-complex was lost during autoclaving. The fish in A, receiving this poor-quality food, were obviously suffering vitamin B-complex deficiency in general and, therefore, their rate of growth was slow. The growth rate of fish in C was still slower, and was almost stopped at the end of the second week. The batch of fish in C had to fight against an additional handicap, i.e., their environment was limited to one gallon of water only. In other words, the oxygen available for respiration was so reduced as to lead to respiratory insufficiency, which was

one of the major contributory causes of their early death. Hence when both the living space is badly narrowed down and the food is of poor quality, growth is restricted and even stops, and death follows soon after. The proteolysed whole liver, fed to fish in B, contains a high percentage of proteolysed protein in an easily digestible condition, with most of the essential amino acids in the form of proteoses and peptone, and it contains vitamin B-complex, anti-anaemic principles, and folic acid. The fish in B went on growing to a maximum collective weight of 36 grammes in the course of the comparatively short period of four weeks, although the condition of space and quantity and quality of water were the same as in A.

Besides growth, the changing of greyish brown to black pigment over the back and in the stripes on the sides of the body of the inmates of B was probably due to the presence of pantothenic acid (which is said to prevent greying), a component of vitamin B-complex of which liver is an extremely rich source. The evidence of growth response by the fish in B, and of nutritional achromotrichia (depigmentation) by the fish in aquaria A and C, find clear parallels in the recent works of Barbara, Maclaren, *et al* (1947) on trout, and of György, Polling and Subbarow (1940) on rats and mice, respectively. It may also be concluded that the black back and the black striated sides that are typical of wild murrel may be the result of concentrations of black chromatophores in those particular areas, and the foundation of such a concentration might be well regarded as being laid in the fingerling stage. Therefore, the success of the degree of black pigmentation achieved by a young murrel may be accounted for by the existence of such natural foods rich in vitamin B-complex as are present in their natural habitat in the form of various fresh-water planktons.

In a word, for fish as for men, life is a series of stimulus-response phenomena depending on the degree of physiological or complex nutritive equilibrium, and the well-being and healthful longevity of fish can be promoted not by copious feeding of any or every kind of food, but by a generous provision of a well balanced diet beginning in the early stage of life. An abundant living space is also essential.

The author feels extremely grateful to Dr. M. Rahimullah, the Fisheries Officer, for his valuable suggestions and encouragement in this study, and to Professor F. E. J. Fry, of Toronto University, Canada, for correcting the manuscript, and for his keen interest and encouragement throughout the work. Thanks are also due to Mr. S. M. K. Moinuddin, the Photo-artist in the department, for helping in preparing the growth chart.

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An Experiment with Snake Trapping

By Lucas M. Dargan and William H. Stickel

THE value of funnel traps for bull-snake control was demonstrated by Imler (1945). The feasibility of using these traps for snake population study was tested on the Patuxent Research Refuge in 1946 and 1947. Since further work with the traps is not planned for the near future, comments on the method are offered for the consideration of those interested in similar studies.

The traps are modeled after those described and figured by Imler, but are 4 feet long and 18 inches wide instead of 6 feet long and 24 inches wide. The smaller size of the traps makes it easier to reach animals in corners or wedged beneath funnels. The smaller traps are also less expensive to construct and easier to transport. Within each end of a trap there is a 14-inch funnel, the inner end of which is 4 or 5 inches above the floor. Each funnel is divided by a vertical partition and hence has two inner openings, each 2 inches wide and 2½ inches high. The partitions are joined to drift fences. These fences are 12 inches high and extend 25 feet from each end of the trap. A 2-foot wing is placed obliquely at each corner of the trap to help guide snakes into the funnels. Animals are removed through a door in the top of the trap. Traps, fences and wings are made of ¼-inch mesh hardware cloth.

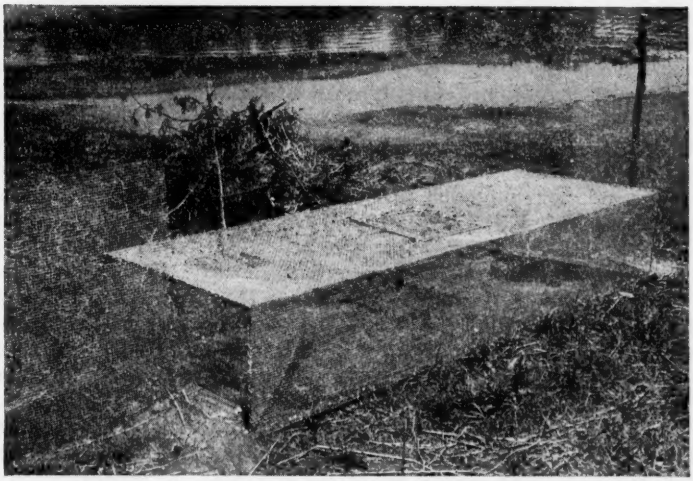
The traps are not baited. Animals simply come to the drift fence and follow along it into the trap. The traps are therefore exceedingly unselective. They catch everything from insects to mammals. Most animals die unless traps are visited at least once a day. Traps should be covered with boards or vegetation to provide shade, even if they are in woods. Few reptiles will die in the traps if this is done, but many amphibians, birds and mammals will still succumb. For this reason funnel traps should not be recommended to the public for capture or control of snakes or other animals. When carelessly tended they are wholesale slow death traps. Game and other legally protected animals are among those killed. The number of deaths probably could be reduced by keeping food and water in the traps. This might also increase the catch. It would, however, add greatly to the difficulty of the project.

Our traps were set in an upland pine-oak woods where other studies in progress made possible frequent visits. Sixteen traps were arranged in a grid of 4 rows of 4 traps each, with traps 330 feet apart. The area within the grid was 22.5 acres. Both size of area and number of traps were far too small, as shown below, but circumstances made a more extensive trial infeasible.

The drift fences were placed to meet fallen logs, small ravines or other natural objects that might direct animal movement. One corner of the grid was 290 feet from a 50-acre lake. The traps were operated from the last week of May until mid-November in 1946, and from the first week of April until mid-November in 1947.

Effectiveness of Traps.—Upland pine-oak areas on the refuge are con-

sidered relatively unproductive habitats.[1] The number of animals caught in the two years is therefore of some interest. Sixty-seven snakes of five species were collected: 22 *Coluber constrictor,* 36 *Heterodon platyrhinos,* 6 *Elaphe obsoleta,* 2 *Thamnophis ordinatus,* and 1 *Lampropeltis getulus.* The catch of 67 snakes represents approximately the capture of one snake per 93 trap-days. In addition, the traps caught 918 frogs and toads, 14 lizards, 25 box turtles, 17 birds, and 109 mammals. The most surprising feature was the capture of so many hog-nose snakes, for only 6 had been found on the entire refuge in the two preceding years.



Photograph by F. M. Uhler

Fig. 1. Snake trap on lake shore. The traps described in the text were similar except that the drift fences were no taller than the trap, and a short wing was placed obliquely at each corner of the trap. The brush in the background was spread over the trap to provide shade.

Snakes being released were allowed to crawl from the carrying bag at points near the drift fence. The animals usually crawled along within 6 inches of the fence and into the trap without trying to climb the fence. Snakes rarely raised their heads more than 4 or 5 inches from the ground, although many moved back and forth energetically, poking their noses into the wire dozens of times. Two snakes crossed the drift fence when they came to one of the stakes supporting the fence. One crossed the fence when it came to a knapsack placed at the end of the fence. Two others crossed voluntarily where there were no obstructions. The tendency for snakes to climb the fence when they came to stakes was largely eliminated by replacing the round stakes with thin, tapered laths. Stakes of heavy wire would be even better.

[1] The physiography and plant ecology of the Refuge are outlined by Hotchkiss and Stewart, 1947.

Longer drift fences probably would have been more effective. It would not be good, however, to extend a drift fence more than ¼ the distance between traps. Longer fences would interfere too greatly with normal travels of the animals.

Several snakes were put back into traps to see if they could escape. Hog-nose snakes apparently were unable to get out, but some of the black racers escaped within a day or two, probably through the funnels. Small doors of hardware cloth were then hung over the inner ends of the funnels to prevent escape. Some snakes entered the traps readily despite the doors. Others of the same species turned and left the funnels without even touching the obstructing doors. No hesitancy to enter the traps was noted when the doors were absent. The first step in future work with snake traps should be to modify the trap so that the funnels permit free entry but prevent escape.

The top door of our trap is a square of mesh large enough to overlap broadly the hole it covers. It is hinged to the trap, and is kept closed by a metal rod that crosses the trap and hooks into both sides. We have no reason to think that snakes ever escaped by forcing up one edge of the door, but it seems entirely possible that they would. A simpler yet more secure closure could be made by removing the mesh door and sewing to the opening one end of a cloth cylinder, such as a collecting bag open at both ends. The free part of the cylinder would be bent double and tied like a snake bag.

Use of Traps in Population Studies.—The percentage of recaptures on the 22.5-acre trapping plot was low, as was to be expected from the small size of the area. There were only 13 returns in the two years. The returns were divided almost equally between *Coluber* and *Heterodon*. Only one *Coluber* and one *Heterodon* were taken both in 1946 and 1947.

All of the snakes that were trapped apparently ranged beyond the limits of the plot, for all recaptured adults had at least one collection in a marginal trap, and movements entirely across the grid were not uncommon. It is evident that the traps were catching snakes from an area considerably larger than the grid. Judging by the frequency of travels across the grid, there can be little doubt that some snakes trapped in the study area ranged at least the plot's diameter beyond its borders. The traps were thus drawing on, though not trapping completely, an area with a diameter three or more times the width of the grid.

There are several other factors that may have helped prevent a larger number of recaptures. The snakes that spent the most time in the trapped area perhaps learned to avoid the traps. Some of the black racers may have learned to escape from traps. It is also possible that there was a relatively high proportion of transient snakes, for some of the trapped snakes may have been traveling to or from the lake. The primary reason for the scarcity of repeats, however, probably was the smallness of the plot in relation to the ranges of the snakes.

The wide ranges of the larger species of snakes present the main difficulty in using traps for population study. In order to determine population density or home range size it is necessary to have a study area large enough to enclose completely the ranges of several individuals. If an area is smaller, the ranges of most individuals overlap the plot boundaries, which makes

it difficult or impossible to interpret results. Animals that range primarily outside a small plot are rarely caught; few if any individuals are largely resident within the plot and thus available for frequent capture.

An area three times the diameter of an average home range is probably the minimum for satisfactory population study. For many species it would be out of the question to cover so large an area with a grid of evenly spaced traps. The home range of the black racer may be 1300 feet in diameter and probably is not much less, at least in poor habitat (Stickel and Cope, 1947). A square area three times this wide would include 349 acres and would be ¾ of a mile across. This is a fairly typical example, for Fitch (1949) has shown that several species of large Californian snakes have home ranges similar in size to those of *Coluber* and *Elaphe* at the Patuxent Refuge. The similarity may be coincidental, however, for home range size varies widely with the habitat. Little is known about range sizes among the smaller snakes, but the work of Siebert and Hagen (1946) demonstrates that under certain circumstances their ranges may be very restricted. The population studied by these authors may have represented an unusual concentration, with consequent unusual behavior.

Another factor that the worker must consider is trap spacing. If traps are too widely spaced there will be few recaptures. It will be difficult to determine the range size even roughly, and almost impossible to decide which individuals are residents, border residents, and transients. Good data on one or both of these subjects are essential in making reliable estimates of the population. Suitable trap spacing is therefore of critical importance. Both theoretical considerations and experience in mammal trapping suggest that it is not adequate to use a spacing that will result in two traps within an average range diameter. The minimum for satisfactory work seems to be three traps within the average range diameter. This permits recaptures in enough different traps that workable data can be obtained. The optimal spacing is perhaps 4 or 5 traps per range diameter. In most studies it is better to use the available traps to increase the size of the area trapped than to space the traps more closely than 3 or 4 per range diameter. This is because of the need of getting data on enough individuals to make a significant sample.

It has been suggested above that there should be at least 3 traps per average range diameter, and that the study area should be at least three times as wide as an average range. On a square grid this would mean 9 rows of 9 traps each. It is therefore necessary to use at least 81 traps for serious population work. It is also necessary to have some idea of the range size before beginning intensive trapping. If this cannot be obtained from the literature the worker will have to make preliminary studies with marked animals, either with or without the aid of traps.

Traps need not be set at regular intervals on a grid, though such spacing does simplify analysis of results. Traps may be set at random, or in any spots the worker considers favorable. But the study area must be of adequate size, distances between traps must be known, and traps must be close enough together that there are a few of them within the ranges of most individuals. It is desirable for the study area to approach a square or circle in shape, for

very elongate or irregular areas yield data that may not be subject to satisfactory interpretation.

The difficulty of trapping areas large enough for the study of large, active species of snakes could be avoided in part by periodically moving the traps. This is less practical than might be thought, for it is a long, slow job to transfer the equipment and emplace the fences. Each drift fence must be laboriously adjusted to the contours of the ground, and each trap must be set flush with the surface. The drift fence trap is essentially a semi-permanent installation.

A more practical solution would be to place traps varying distances apart over an area of suitable size, setting each trap at a promising but readily accessible site, preferably one that could be reached by automobile. This practice is generally followed in live-trap studies of small-game mammals, whose wide ranges also make large study areas necessary.

The suggestions we have made about trap spacing and size and shape of study area are believed to be valid under most field conditions if the object of the study is to obtain good population data. It is probable, however, that unusually favorable circumstances would make it possible to get usable data with fewer traps or a relatively smaller area. This would be true, for example, if many collections could be made by hand in and around the trapped area; or if the study area were a very small island. It should not be assumed, however, that an isolated habitat is an "ecological island," and that it can be studied as such. There is more movement to and from "ecological islands" than is often suspected. Exploring animals frequently travel long distances with surprising rapidity, especially across habitats that are unsuitable for them.

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The Blue-tailed Skinks (*Eumeces*) of Two North Carolina Coastal Islands

By William L. Engels[1]

BOTH of the common blue-tailed skinks, *Eumeces fasciatus* Linnaeus and *E. inexpectatus* Taylor, occur apparently throughout the North Carolina Coastal Plain. Taylor (1935) recognized both species in collections from Kinston, New Bern, and Beaufort. He also identified a broad-headed skink, *E. laticeps* Schneider, from Beaufort. Since Beaufort is on the coast, and since New Bern and Kinston are on broad rivers of the coastal plain, it might be expected that all three *Eumeces* would have reached the islands of the North Carolina "outer banks." This, however, is not the case, for at least on two of the islands, the skink population appears to be composed solely of *E. inexpectatus*.

There are at hand small collections from Harkers Island (24 specimens) and Shackleford Banks (21 specimens). Both islands are in Carteret County, North Carolina. Shackleford Banks is one of the series of off-shore bars that forms the Outer Banks; at its western end, opposite Beaufort, it lies less than 2 miles off the mainland shore. Harkers Island is probably one of an older series of off-shore bars; it lies 3 miles east of Beaufort, between Shackleford Banks and the mainland.

Of the 21 specimens from Shackleford Banks, the characteristic light lines are absent only from the 2 largest specimens; each of these has 32 scale rows around the middle of the body, and the median subcaudals are only 1.14 and 1.06 times the width of the adjacent scales. In *none* of the 19-lined specimens does the dorso-lateral line follow the 3rd scale row; in 16 specimens it is on scale rows 4 and 5 on both sides of the body, while in the other 3 it is confined to scale row 4 on one side, but follows rows 4 and 5 on the other. In no specimen does the lateral line follow the 6th scale row; it is confined to the 7th row in 3, follows row 7 and 8 in the remaining 16. In one of these it is on row 7 alone on one side, but on rows 7, 8 on the other. The specimens range in size from 43 mm. (snout-vent length) to 75 mm., averaging 60.8 mm. The number of scale rows around the middle of the body averages 31, 7 having 30 rows, 5 having 31, and 9 having 32. The ratio in width of the median subcaudal scales to the adjacent scales averages 1.16:1, ranging from 1.01:1 to 1.27:1. These latter measurements were made with an ocular micrometer on a binocular dissecting microscope; the method does not permit exactitude, and the ratios are to be taken as approximations only, which are, however, less subjective than the notation "sub-caudals *not* distinctly widened."

The series from Harkers Island is similar, except for a tendency for the light lines to be confined to one scale row, and except for a slightly higher frequency of the lower number (30) of scale rows. In 23 of the 24 specimens the lines are sufficiently distinct to determine that neither the 3rd nor 6th

[1] Acknowledgment is due the Director, U. S. Fish & Wildlife Service, through Dr. H. F. Prytherch, for many courtesies at the Fisheries Biological Laboratory, Beaufort, North Carolina.

rows is involved. In 8, the dorso-lateral line is confined to the 4th row (both sides); in 14 it follows rows 4 and 5 on both sides; in one it is confined to row 4 on one side, but follows rows 4, 5 on the other. The lateral line is confined to row 7 in 9 specimens, follows rows 7, 8 in 10, and in 4 cases is confined to row 7 on one side, but follows rows 7, 8 on the other. These 24 Harkers Island specimens range from 34 mm. snout-vent length to 74 mm., averaging 55.3 mm. The number of scale rows is 30 in 11 specimens, 32 in 9, 31 in only 4. The median subcaudal scales average 1.18 times the width of the adjacent scales, ranging from 1.10:1 to 1.28:1.

There is available for comparison only a small series of *Eumeces* spp. (19) from the vicinity of Chapel Hill, in the east central Piedmont. Five of these agree with the island series in having relatively narrow subcaudals (1.08–1.21 times width of adjacent scales) and high number of scale rows (30, 30, 31, 31 and 32). Of the 4 that still show lines, the dorso-lateral line is on scale rows 4, 5 in each; the lateral line is on rows 7, 8 in 2 specimens, and on row 7, only, in the others. These 5 Piedmont specimens, and all of the island specimens, are referred to *E. inexpectatus* Taylor, on the basis of the characteristics described above.

On the other hand, 14 of the 19 Piedmont specimens have wider median subcaudal scales (1.32–1.70 times width of adjacent scales, averaging 1.44). Of the 11 specimens in which the lines have not yet been lost, 9 have the dorso-lateral line on rows 3, 4 rather than 4, 5; in the other 2 the line is confined to row 4. Six have the lateral line on rows 6, 7 rather than 7, 8; in the other 5 it is confined to row 7. None of these 14 specimens has more than 30 scale rows around the middle of the body; one has 27, 2 have 28, 2 have 29, 9 have 30 scale rows. The individuals are of comparable size to those from Harkers Island and Shackleford Banks, ranging from 43 mm. snout–vent length to 71 mm., averaging 61.1 mm. The relatively widest median subcaudal scales were found in the smallest individual (43 mm.), next widest in an adult male, 64 mm. snout–vent length.

It is clear that each of the specimens from Harkers Island and Shackleford Banks differs from the majority of Piedmont specimens in having relatively narrower median subcaudal scales (1–1.3 times, rather than 1.3–1.7 times width of adjacent scales), dorso-lateral line on scale rows 4, 5 rather than 3, 4, lateral line on rows 7, 8 rather than on 6, 7, and as a group they have a larger number of scale rows around the middle of the body (30–32 rather than 27–30). Thus, most of the Piedmont specimens are clearly *Eumeces fasciatus*, the specimens from the two islands are all *E. inexpectatus*.

Discussion

The North Carolina "outer banks," of which Harkers Island and Shackleford Banks are members, are in fact off-shore bars, of submarine origin; their fauna is thus an acquired one, which reached the islands across a water barrier subsequent to the emergence of the bars (Engels, 1942). The insular fauna is greatly impoverished in comparison to the mainland, in large part due to lack of diversification of habitat, but there are irregularities in dis-

tribution that apparently cannot be explained on the basis of a habitat deficiency. Thus the oak-toad, *Bufo quercicus,* is abundant on Harkers Island, but does not occur on Shackleford Banks, barely more than 2 miles distant; Fowler's toad, *B. w. fowleri,* is very common on both. Conversely, the common mole, *Scalopus aquaticus,* is abundant on Shackleford Banks, but does not occur at all on Harkers Island despite a much more extensive area there of suitable habitat. It would appear that in such cases of spotty insular distribution, chance and accident have been major causative factors. But in any case, those species whose behavior favors their accidental transport on flood water are more likely to reach the islands.

The habits of *Eumeces inexpectatus* are still largely unknown. Most, but not all, of the specimens collected on Harkers Island and Shackleford Banks were taken from beneath loose bark on standing trees; most, but not all, of the Piedmont specimens described above, including the *fasciatus,* were taken from beneath loose bark of fallen trees. Unfortunately, exact record was not made for each individual, nor, for the Piedmont specimens, whether from upland or flood plain. The causative factors in the almost certain failure of *E. fasciatus* to reach Harkers Island and Shackleford Banks, and the highly probable failure of *E. laticeps* to do so, must remain conjectural; but it seems not unlikely that differences in habit and habitat favored the transport of *E. inexpectatus* and the exclusion of the other two.

Summary

Of the three species of *Eumeces* occurring in the North Carolina Coastal Plain, only *E. inexpectatus* has reached two of the off-shore bars of the Beaufort area, Harkers Island and Shackleford Banks. Variation in some features of scutellation and pattern is given for a small series from each island. Difference in habit and habitat, favoring accidental transport on flood waters, may account for the presence of *inexpectatus* and the absence of *fasciatus* and *laticeps.*

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A New Hylid Frog from Central Veracruz

By Edward H. Taylor

In a large herpetological collection recently brought from Mexico to the Kansas University Museum of Natural History by Mr. Walter W. Dalquest[1] is a single specimen of an undescribed frog. The specimen was discovered in an arboreal bromeliad in December at an elevation of approximately 5000 feet at Huatusco, Veracruz.

Very few places in the world, if any, have a larger fauna of hylid frogs than Central Veracruz. Elevations occur from sea level up to heights beyond where frogs may exist. No doubt this varied elevation in part accounts for the diversified fauna. Five genera and 20 species occur. The genus *Hyla*, as now recognized, is most prolific with 15 species already known, representing several distinctive groups. The other genera are *Agalychnis* with 2 species, *Acrodytes* with 1, *Anotheca* with 1 and *Smilisca* with 1.

The species here described has, in common with *Hyla bistincta* and *Hyla dalquesti*,[2] an elongate anal flap or tube that carries the vent to the ventral level or onto the ventral surface. On the basis of this character it seems probable that these three forms are more closely related to each other than to other members of the genus. Males of *Hyla bistincta* have a distinctive patch of nuptial asperities on first and second fingers. Since the specimen at hand is a female the species cannot be compared on this character.

Hyla cyclomaculata, sp. nov.

Type.—University of Kansas Museum of Natural History No. 26954, ♀, Huatusco, Veracruz, Mexico (elevation 5000 ft.); Dec. 2, 1948, Walter W. Dalquest, collector.

Diagnosis.—A medium-sized *Hyla* (snout to vent measurement 56 mm.); outer fingers more than one-third webbed, toes about four-fifths webbed; a strong inner metatarsal fold; canthus rostralis sharp, distinct; choanae small, half the area of one vomerine tooth patch; vent opening on ventral surface.

Skin smooth on back; belly and ventral surface of thighs granular. Dark brown above with scattered rounded black marks; sides with some nearly circular black spots, with irregular yellow areas; below brownish black with yellow markings.

Description of the Type.—Head broader than long (15.2 x 20 mm.); interorbital width (6 mm.) greater than the width of an eyelid (4.9 mm.); canthus rostralis forming a straight ridge from eye to a point near nostril; snout somewhat rounded seen from above; distance from eye to nostril 4.9 mm., greater than distance from nostril to middle point of upper lip (4.4 mm.); tympanum (2.6 mm). contained in diameter of eye (6 mm.) 2.3 times; distance between tympanum and eye 3.8 mm.; snout flat, the depression between nostrils scarcely discernible; eyes strongly elevated, pro-

[1] The Museum wishes to acknowledge financial assistance from the University of Kansas Endowment Association for Mr. Dalquest's collecting in Mexico.

[2] Originally described as *Hyla proboscidea* Taylor; preoccupied by *Hyla proboscidea* Brongersma. See Copeia, 1, 1949: 74.

Fig. 1. Ventral view of type of *Hyla cyclomaculata*. Actual snout to vent measurement 56 mm. Fig. 2, Dorsal view of type.

tuberant; loreal region distinctly concave, slightly overhung by the canthal ridge, the upper part nearly vertical, the lower sloping to lip; snout extends 1.5 mm. beyond lip; a strong supratympanic fold beginning at eye, passing over tympanum concealing its upper edge, bending down to a point above arm insertion, then rising somewhat, terminating above or a little behind level of arm insertion; no fold on sides of body.

Skin generally smooth above and on the upper part of sides; under magnification, minute corrugations evident on the skin, becoming a little more evident on sides; skin of chin, throat and breast with low rather indistinct granules; on abdomen and ventral part of thighs granules strong, well defined; vent opening on ventral surface of thighs covered by a free flap of skin; legs moderately short, with limbs folded at right angles, heels overlapping 5 mm.; tibiotarsal articulation reaching to a point near anterior edge of eye; fingers and toes with terminal pads, the largest those of third fingers (3.8 mm. in width) and of fourth toe (3.3 mm); first finger somewhat opposed to other three; first and second fingers one-fifth webbed (or less); second and third about one-fourth webbed; between third and fourth, one-third webbed; subarticular tubercles all single; numerous supernumerary tubercles on palm; a large palmar tubercle partly segmented into four parts; a large elongate tubercle at base of first finger; no evidence of a pollex; a series of disconnected tubercles forming a line under forearm; a very narrow indistinct axillary web; toes about four-fifths webbed, the web reaching the disk on the outer side of the first, second, third, and inner side of fifth toe; subarticular tubercles rather small; inner metatarsal tubercle large; a small rounded outer metatarsal tubercle; a strong inner metatarsal fold present.

Tongue broad, cordiform, somewhat emarginate posteriorly; vomerine teeth on two elevated areas each more than twice the area of the choanae; palatal glands open into a continuous sinuous groove lying about midway between level of choanae and front of palate, reaching laterally to level of choanae or slightly farther. Vomerine tooth patches between choanae and reaching their anterior level, separated from each other by a distance one-third length of one vomerine patch and from the choanae by approximately one-half of their length.

Color.—Deep brown above, lighter dorsolaterally with rounded dark spots on back, very indistinct or absent on head; side of head, especially in loreal region, nearly black; on sides and in groin yellow with numerous circular or irregular black spots; limbs as well as hands and feet with deep blackish brown spots or bars; a few small light dots on the front and back of thigh; belly brownish black with irregular yellowish areas, the top of each granule being cream or yellow; some yellow areas with dark spots under the shank.

Measurements in MM.—Snout to vent 56; width of head 20; length of head from jaw angle 15.2; foreleg 33; hind leg 86; tibia 30.5; foot and heel 38.

Remarks.—The species may readily be distinguished from *Hyla bistincta*, found in the same general area at higher elevation, by the immaculate cream

ventral surfaces of body of the latter; the nostril a little nearer the eye than middle of the upper lip edge; the canthus indistinct or absent; the absent or very indistinct inner tarsal fold; the larger outer metatarsal tubercle; lesser webbing of the hand; and the greater thickness of the snout with a narrower interorbital distance.

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Courtship of the Plethodontid Salamander *Ensatina eschscholtzii*

By Robert C. Stebbins

THE courtship of plethodontid salamanders, as so far observed, consists of a series of instinctive reactions that form a well defined and predictable pattern of behavior. The complexity of this pattern supports the generally accepted view that the Plethodontidae are a terminal group in phylogeny.

Information on plethodontid courtship stems in large part from the observations of Noble (1929) and Noble and Brady (1930) on captive animals. In studying a number of genera and species, principally from eastern North America, they observed that the general pattern of nuptial behavior was essentially the same even though some species were aquatic and others were terrestrial. They studied the following forms: *Eurycea bislineata, E. guttolineata* (= *E. longicauda guttolineata*), *Manculus quadridigitatus, Desmognathus fuscus, D. phoca, D. quadramaculatus, Stereochilus marginatum, Plethodon glutinosus, P. cinereus, Hemidactylium scutatum, Hydromantes genei* and *H. italicus. Eurycea bislineata* and *Stereochilus* were studied in greatest detail.

I have recently had opportunity to observe the behavior of a western North American species, *Ensatina eschscholtzii,* a form not represented in the

foregoing study. The pattern is an intricate one, differing in certain details from that described by Noble and Brady but agreeing in a general way with their summarization. As a basis for comparisons I quote from their summary:

> In all species, so far as determined, there is a series of preliminary rubbing movements during which the male applies his lips, cheeks, mental gland, or side of body to the snout of the female. This arouses the female's interest in the male. In the second phase of the courtship, the female follows the male, keeping her chin pressed closely against his tail base as they move about. . . . The male, especially when he is not moving forward, undulates the base of his tail from side to side . . . .
>
> At the height of the courtship, after the female has assumed her position behind the male, the latter often turns and pushes the female in the cloacal region with his nose. This causes the pair to move in circles about the aquarium. Another posture and movement not previously reported is the lifting of the body and arching of the tail of the male while the female is following him. This may tend to raise the fore part of the female from the floor. Another peculiar attitude during the same period is the turning forward of the tail of the female in some species, particularly in *Eurycea b. cirrigera* and *Stereochilus*. Still another distinctive position, noted especially in *Stereochilus* and *Hydromantes*, is the forcing of the mental glands tightly over the nostrils of the female while the male maintains a position directly over her back.

Observations of courtship and spermatophore pick-up were observed on several occasions in captive *Ensatina eschscholtzii xanthoptica* from the vicinity of Berkeley, Contra Costa County, California. The behavior in each instance was essentially the same. A typical sequence of steps in courtship is illustrated in Plates I and II, Figures 1 to 10. The diagrams are composite to the extent that the activity of the same courting pair has not been followed through the entire series. On several occasions the behavior of the animals was observed to step 4 in which the male is attempting to induce the female to follow him. And at other times the animals were discovered in the "tail walk," stage 5, and were watched to the culmination of courtship, at stage 10.

A large adult female with ova approximately 2.5 mm. in diameter was placed in a terrarium (14″ x 36″ x 16″) on November 25, 1948, with an adult male. The animals were observed daily and were frequently watched at night when they came out from cover to forage. On February 6, 1949, at 3:45 A.M., the first courtship activity was seen. The pair was found in the "tail-walk" (Noble, 1931: 389), stage 5 (Plate I). The observation was made under the illumination of a red Christmas tree light placed at one end of the terrarium. The animals appeared to be disturbed by the sudden illumination and by my movements. The female broke away from the male after 10 minutes and both animals sought the shelter of a board at one end of the tank. I moved them into the open and, despite handling, the male immediately again showed an interest in the female as she crawled toward cover. He moved quickly to her side, crouching low with his chest nearly touching the ground, whereupon she paused momentarily (Fig. 1). He then proceded stealthily forward with his snout turned toward her. He appeared to touch her lightly with his nose but I am not certain that contact was made. As his head was brought near hers, his forward progress became almost imperceptible and he seemed to nose her gently along the side of the face. He brought his nose up against her gular area whereupon she raised her head, assuming

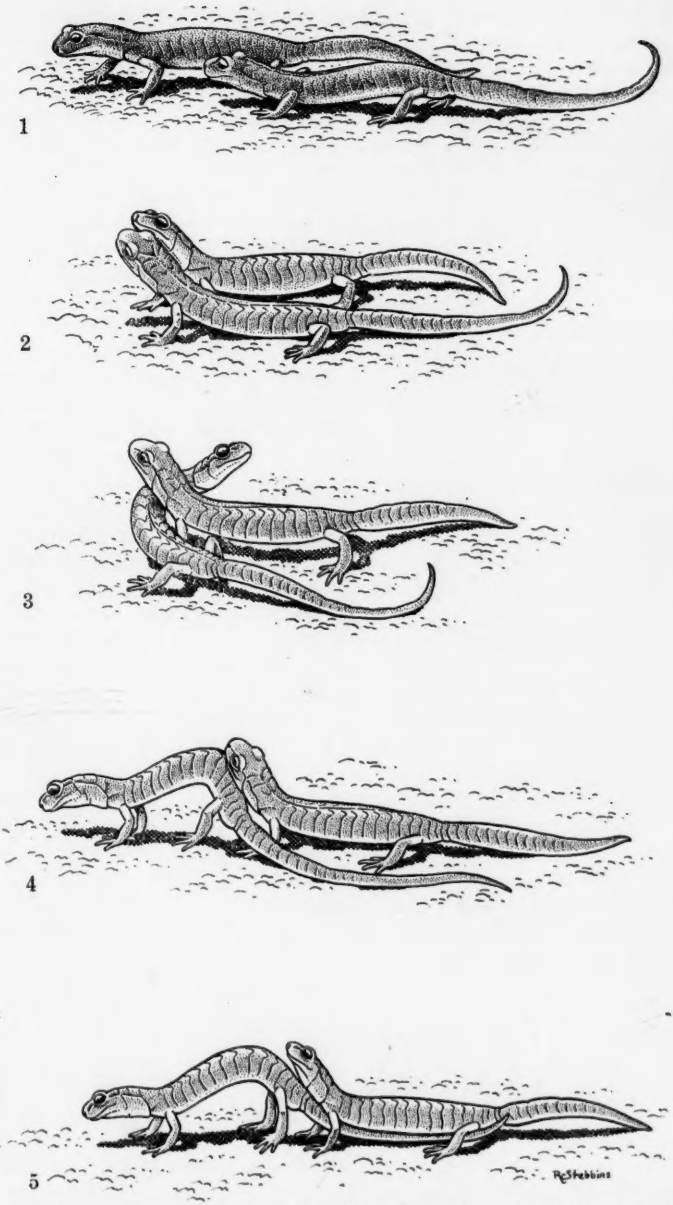
the pose shown in Figure 2. Both animals remained in this position for several seconds until the female turned aside and sought shelter. The male pursued her.

The next night, at 3:35 A.M., the pair was again found in the "tail walk" but a few seconds after the red light was turned on the animals separated.

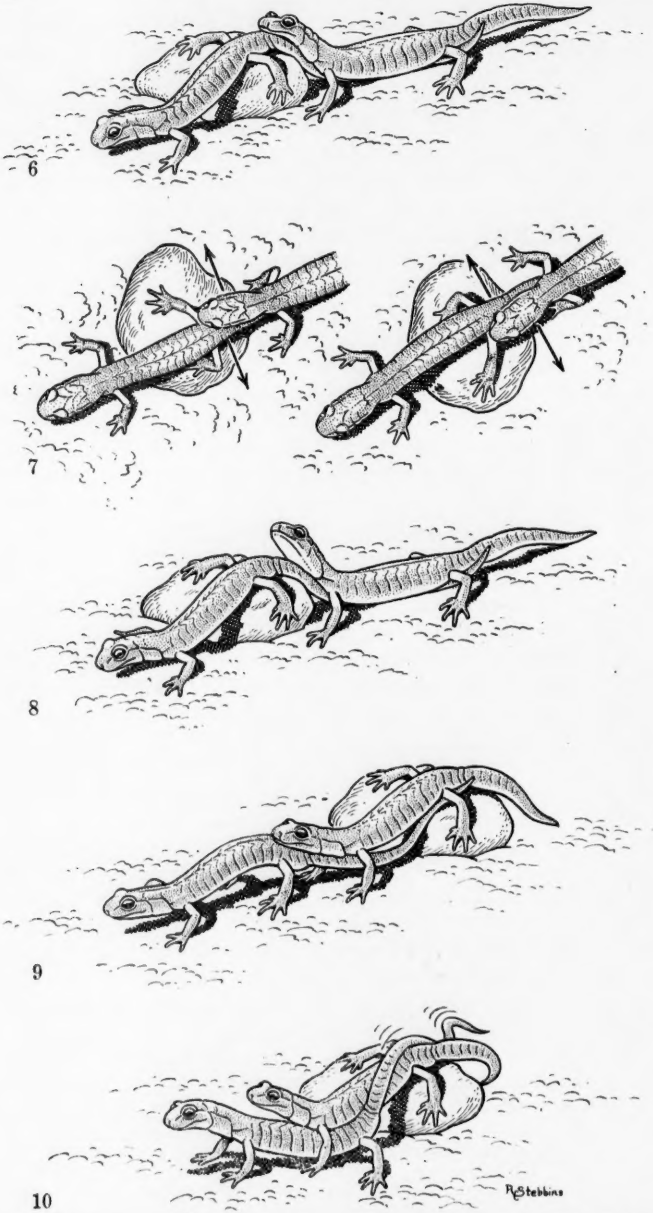
Again on February 8 the animals were found courting. The sides of the terrarium had now been darkened with sheets of black paper with a small opening at one side for observation. A 15-watt photographic ruby light replaced the Christmas tree bulb and was placed 4 feet directly above the terrarium. Several thicknesses of cloth covered the top of the tank producing a subdued diffuse light, thereby eliminating the point source of illumination that previously appeared to have been disturbing to the animals. The male stalked the female intermittently from 11:30 P.M. until 4:30 A.M. After this, on subsequent nights, his interest in her began to wane. On March 15, 1949, he was killed and the vasa deferentia were found to lack sperm. The animal had been in captivity since January 8, 1949, at room temperatures of approximately 70 to 80 degrees. He probably was rendered sterile by these temperatures since field animals were found heavily laden with spermatozoa throughout this period.

On February 12, 1949, I placed another male, fresh from the field, with the female. On February 14, at 10:00 P.M., I turned on the red light to find both animals out on redwood leaf litter that had been placed at one end of the tank. The male, unconditioned to the light, immediately sought cover. Some minutes later he came out again and crawled near the female. He courted her for about an hour but she was refractory. He followed the same pattern of stealthy approach and exploratory nosing of the female engaged in by the other male, but he carried the courtship further. After getting the female into position 2 (Fig. 2), with her head held high, he slid his head past hers, holding it against her gular area, moving forward until his neck was against her throat. He then shifted backward. The movement was repeated several times, resulting in a stroking of her gular area by the dorsum and sides of his head and neck. Throughout this activity the female remained quiet, holding her head at an angle of approximately 45° (Fig. 2). The male then moved his body slowly forward and around to her other side, at the same time maintaining contact with her throat. In this position his body assumed the form of a C that opened toward her and embraced her neck and chest (Fig. 3). He moved until his sacral region passed under her throat. When in this position, he elevated his hindquarters, arching his lower back upward and straightened his hind limbs (Fig. 4). He now began a massaging motion with his sacral area pressed against her throat. He moved his rump forward, down, upward, and back without changing the position of his hind limbs. Since her head rested passively against his back, it tended to shift with his movements. The male seemed to be trying to interest her in this area of his body.

The female was entirely passive, showing no interest in the male, and after a few moments began to crawl forward, stepping on his tail. When he detected her movements, he turned quickly, bending his body sharply, and



A typical sequence of steps in the courtship of *Ensatina eschscholtzii*. Explanation of the figures will be found in the text.



A typical sequence of steps in the courtship of *Ensatina eschscholtzii*. Explanation of the figures will be found in the text.

brought his nose against her gular area again. This arrested her momentarily but she soon turned away. Although she had moved several inches from him, he seemed to be unaware of her absence until she came into view to one side of him. He approached her and repeated the sequence of acts just described but again failed to induce her to follow him. The animals separated and sought cover. No other courtship by this pair was seen, despite the fact that both animals were implanted with adult *Ensatina* pituitaries on February 21.

Another male, fresh from the field, was placed with the above female on February 26. He was observed courting her from 10:00 P.M., intermittently, until 4:25 A.M. when both animals sought cover. Several times during this period he induced her to follow him but no spermatophore deposition occurred.

On March 12 an adult male and female were obtained in the field and were placed in the terrarium on the 13th at 7:00 P.M. The animals were watched for an hour under the illumination of the red light. During this time they took no interest in one another but were intent upon getting out of the terrarium. I resumed my observations at 12:15 P.M. The light had been on since 7:00 P.M. The male now was leading the female about in the "tail walk" (Fig. 5). Forward movement was slow although he was continuously active. This activity consisted of an alternate lifting of the feet and a lateral pendulum-like movement of the body while the hindquarters remained essentially stationary. He stepped sideways with his fore feet until the long axis of his body projected at an angle of about 45° from an anterior projection of the long axis of the body of the female. He then reversed his position, shifting a similar distance to the opposite side, thereby describing an arc of about 90° that commonly required from 12 to 14 seconds for its execution. At the same time the hind legs were lifted alternately, in a walking motion, or successively on one side and then the other or in an irregular manner. One or the other of the hind limbs was lifted at intervals varying from 3 to 54 seconds but commonly at 5 to 8 seconds during peaks of activity. Through all this the lower back was sharply convex. The limb movements suggested an animal walking on a hot surface. During the lateral sorties of the male, the female rested with most of her body against the ground with his tail extending between her legs. His movements resulted in some stroking of her gular area, since she tended to keep her head directed forward while his sacral region shifted slightly from side to side as he moved his foreparts. Perhaps movements of the hind limbs have something to do with expelling the secretion from the abdominal glands, observed to have a hedonic function in other species.

The pair followed a circuitous route about the terrarium. The male, on a number of occasions, made a sharp 180° turn, one time crawling over the hindquarters of the female. She was obliged to bend nearly double in her tenacious effort to maintain the sacral contact. The "tail walk" lasted until 2:10 P.M. During this period of approximately 2 hours, the animals covered 10 or 12 feet. The male's activity was incessant but the female stepped forward only as necessary to maintain her position in relation to him. Throughout the process, his tail curled upward behind one or the other of her

hind legs. Contact here may have helped to keep the female with the male as he moved forward. Probably of greater importance, however, is some attracting substance in the skin of the sacral area of the male since in another pair a male with a tail too short to reach the hind limbs of the female was followed. The sacral region appeared to glisten more in courting males than the remainder of the dorsum, suggesting greater secretory activity in this area of the skin. During the last half hour of courtship, prior to spermatophore deposition, the male became increasingly active and appeared to be uneasy. Several times he elevated his fore parts against the side of the terrarium. Finally he came to a rock, over which he crawled. When his hindquarters came into contact with it, he stopped. He now extended his hind legs laterally and rested his fore parts on the ground beyond. The female stood quietly in the "tail walk" position (Fig. 6). With his vent against the rock, the male began a rhythmic swaying motion of his pelvis accomplished by rocking from side to side on his hind limbs. The feet were not moved during the process. The movements at first were so slight as to be almost undetectable but they increased in scope, though not notably in rate, until the sacral area of the male was moving approximately 6 mm. As the movements of the male became pronounced, the female responded by moving her head laterally, counter to his movements. At first I thought her strokes an illusion because of the movement of the male in relation to her, but with increase in their extent they became unmistakable. At the peak of her performance she moved her head approximately 6 to 10 mm. laterally. As the female assumed the rhythm, the movements of the male subsided. The female stroked the sacral area of the male 72 times, counting from the time when the strokes first became noticeable. She moved at the same rate as the male, at somewhat under 1 second. At no time was there appreciable acceleration or retardation of movement although there was a marked rise and fall in intensity. Shortly after the male ceased his activity, the female began to reduce the intensity of hers and finally lifted her head, breaking contact with his sacral area (Fig. 8). For several seconds both animals were motionless. Then the male began to crawl forward. As he moved, the female resumed the "tail walk" position (Fig. 9). Lifting of the gular area from the lower back of the male may have been the signal for this step. As the animals crawled forward, I tried to see the spermatophore but their bodies concealed it. The male took a few deliberate steps, in contrast to his earlier behavior in the "tail walk." He stopped when the cloacal region of the female was directly over the spermatophore. Neither member of the pair looked backward nor was there any exploration of the area by the female prior to the assumption of the new position. As soon as her vent was over the spermatophore the male suddenly and vigorously shifted his entire body posteriorly, slipping beneath her and momentarily lifting her fore parts above the ground. Her head now was just behind his shoulders. At the same time, he swung his hindquarters laterally and drew his tail from beneath her body, whipping it up over her back. His tail writhed violently in a series of grotesque contortions, while its base was pressed against her sacral area and lower back, seemingly aiding her in pressing against the rock with her cloaca. The tail

behaved much like a severed tail. Its movements were at first fast, perhaps 2 or 3 per second, with greatest activity at the tip. Initially the base of the tail was moved in a slapping motion but it soon quieted while the tip palpated the base of her tail and sacral area (Fig. 10). A loop repeatedly formed at the tip of the tail which facilitated the stroking action. No movements of the pelvic region of the female were noted during the caudal activity of the male nor was there any gular contact. The female now lost interest in the male and moved away from him. She did this at first deliberately and rather slowly but after completely disengaging herself she seemed suddenly to become nervous and began to move actively about the terrarium, seeking escape. The male immediately pursued her in the manner shown in Figure 1. His tail was still writhing and continued to do so for a half minute or more after their separation. He followed her to cover.

At 3:00 A.M. I returned for further observations and found the pair again in the "tail walk." They continued this performance until 6:10 A.M. when, after some minutes of obvious uneasiness, the female began crowding the male. She repeatedly stepped on his hind legs and finally left him to seek shelter. The male followed. It had been growing steadily lighter since 5:50 A.M. and by 6:10 the red glow in the terrarium had been replaced by daylight. The female found cover at 6:20 A.M., with the male still intent upon courtship despite the well illuminated surroundings. At 9:20 A.M. I examined her and found a whitish sperm capsule protruding from her vent. A small patch of gelatinous material was present on the surface of the rock. On March 15, at 8:00 A.M., about 24 hours later, a remnant of the capsule was still evident in the vent of the female.

On the night of March 16–17, the same pair courted again and at 7:30 A.M. on March 17, the female was found with a second sperm capsule.

On March 18 at 11:45 P.M., I discovered one of two captive males courting the female obtained November 25, 1948. She previously had been persistently disinterested in sexual activity. Perhaps pituitary implants performed February 21 were responsible for her activation. Spermatophore deposition was observed at 4:45 A.M., 5 hours from the time the "tail walk" was first seen. The nuptial pattern was essentially as observed in other pairs. One aspect of courtship not noted earlier was the behavior of the male when the gular-sacral contact was lost during the "tail walk." Six times during the "tail walk" the male made a sharp turn, causing his sacral area to swing away from the throat of the female. Each time separation occurred, he stopped his pendulum action (p. 277) and forward motion and waited until the female replaced her gular area. When she delayed in this, he engaged in a lateral massaging motion, rubbing his sacral region against her until she moved her head into place. During spermatophore pick-up by the female, the male stroked her rhythmically and slowly (about 1½ to 2 seconds per movement) with the distal 25 to 30 mm. of his tail. At the same time he raised and lowered her body in time with the tail movements by moving his hindquarters. After a minute or so this movement was terminated but the tail strokes continued for 2 or 3 minutes. The spermatophore was deposited on the ground in a level area. At 8:00 A.M. I examined the female and found

that insemination had been unsuccessful. The sperm capsule adhered to her body 4 mm. to one side of her vent.

In comparing the courtship pattern of *Ensatina* with that of other plethodontids as summarized by Noble and Brady (1930), I may call attention to the following:

(1) As reported by these authors for other species, there is in *Ensatina* a series of preliminary rubbing movements during which the male applied his lips, cheeks, and side of the body to the snout or gular area of the female. This seems to arouse the interest of the female in the male. There is no indication that male *Ensatina* possess a mental gland. Inspection of the intermandibular area under the dissecting microscope and observations of behavior have failed to indicate such a structure. Micro-sections are required to settle this matter.

(2) The courting pair engages in a "tail walk" essentially as described by Noble and Brady (1930) but there was no lateral undulation of the tail nor any nosing of the cloacal region of the female by the male. Although there was lifting of the body of the male during spermatophore pick-up, this was not observed during the "tail walk" as mentioned by Noble and Brady. There was likewise no arching of the tail of the male nor turning forward of the tail of the female. The tail was used, however, in stimulating the female during spermatophore pick-up.

In all races of *Ensatina eschscholtzii* there is marked sexual dimorphism in length and thickness of the tail. Females have stout tails, usually shorter than the body, while the tail of the male is slender and as long or longer than the body. In some individuals, as one mentioned by Gnaedinger and Reed (1948), the tail of the male may be one and one-half times as long as the body. Prior to the present observations I had found no explanation for this difference. It is clear now that the long whip-like tail functions importantly in courtship.

(3) Whether there are hedonic glands in this genus is not known. In view of their widespread occurrence in plethodontids, they are expected. Examination of the skin of the two sexes under the dissecting microscope reveals no clear differences in glandular equipment, although the swollen lips of the male may result from more extensive glandular development about the nasolabial grooves. *Ensatina* may resemble *Aneides* (*aeneus* and *lugubris*) in which apparently homologous glands have been found in both sexes.

(4) There are no obvious sexual differences in size or form of the teeth. Dentitional dimorphism has been reported in *Hydromantes, Aneides, Eurycea,* and others. In *Ensatina* the teeth were not used in stimulating the female. Noble and Brady (1930) suspect their use by male *Hydromantes.*

Courtship of *Ensatina* has not been observed in the field. In the vicinity of Berkeley, it is known to occur over a considerable period, however, since sperm capsules have been found in the vents of females on the following dates: November 13 and December 4, 1948, and February 5 and 12 and March 12, 1949. Males possess spermatozoa in large quantities in their sperm ducts upon their first appearance following the fall and winter rains in October and November. Active spermatozoa are present throughout the

period of surface activity which for the adults is largely over by April (as based on a three-year study of a local marked population). The long period of reproductive activity, the ability of the females to store spermatozoa, and repetition of the act of courtship, help to insure fertilization of eggs that are not laid until late spring or early summer. Intensive study of a local population reveals that fully adult individuals are scarce, are of scattered occurrence, and are inclined to solitary habits. Furthermore, activity on the surface is profoundly affected by thermal and moisture conditions, which may fluctuate considerably. These factors militate against successful impregnation of the females but their effect is offset by the aforementioned traits of the animals.

Summary

Courtship in *Ensatina eschscholtzii* consists of a sequence of instinctive acts that form an integrated and predictable pattern of behavior. For clarity this pattern may be considered in a series of stages. (See Plates I and II.)

(1) Stealthy approach by the male, during which he stalks the female, crouching low and moving slowly to her head region.

(2) Massage of the throat and snout of the female by a rubbing action of the male's head and neck.

(3) The "tail walk" in which the male leads the female about with his back arched upward and his tail between her legs. She applies her gular area to his sacral region throughout this process.

(4) Spermatophore deposition, accompanied by a lateral swaying of the hindquarters of the male, followed by a stroking movement of the throat of the female against the sacral area of the male.

(5) Insemination accomplished by a forward movement of the pair in the "tail walk" until the vent of the female is over the spermatophore. The female then squats on the spermatophore and is stimulated by the male who shifts posteriorly beneath her and who at this time strokes her back with his tail.

Throughout the nuptial activity the male is the aggressor and appears less sensitive than the female to stimuli unrelated to courtship. He may pursue the female under daylight conditions, when her only interest seems to be to seek cover.

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Notes on Philippine Sea Snakes of the Genus *Laticauda*

By Albert W. C. T. Herre and D. S. Rabor

ONE of the most interesting families of snakes is that of the Hydrophidae, or sea snakes. On account of the remoteness of their habitat, and the difficulty of keeping them alive, these marine snakes of the tropical Indo-Pacific are perhaps less known to herpetologists of the United States than any other group of serpents. The senior author was especially interested in the sea snakes during his stay in the Philippines, and has collected and studied them ever since 1920. For some years the species common in Manila Bay were kept in captivity and their feeding habits observed. A small live eel placed in the tank with sea snakes was bitten, died in a minute or less, and was then swallowed. Part of the interest in snakes at the Philippine Bureau of Science was on account of the little-known marine eels to be obtained from their stomachs.

But little study was needed to reveal that in many places these highly venomous reptiles occurred in rather large numbers. For several years the senior author lived opposite old Fort San Antonio de Abad, on the water front at the south end of Manila. It was a frequent occurrence for fishermen to haul a beach seine there, and usually a number of sea snakes would be in the catch. Sometimes more than a hundred would be taken at a single haul. They were usually either *Lapemis hardwicki* Gray, or *Hydrophis inornatus* (Gray), or both, though at least three other species were also taken from time to time.

Under favorable circumstances sea snakes are abundant in their native habitat. Even those species that seem to be rare are really common if one goes to the right places to search for them. Such places are the rocky and usually cavernous coral limestone islets where sea snakes resort to breed.

As an illustration of the actual abundance of some sea snakes as opposed to their apparent scarcity in collections, we cite the case of *Laticauda semifasciata* (Reinwardt). Although by no means the longest, this species is easily the largest of the East Indian species. A specimen of *L. semifasciata* 2 meters in length is two or three times as large as an example of *Hydrophis cyanocinctus* Daudin of the same length.

The first Philippine record of *Laticauda semifasciata* was by E. H. Taylor (1922, 1928), who mentioned a specimen "nearly 2 meters in length," at Silliman Institute, Dumaguete, Negros Oriental Province. This was the only specimen of this species that Taylor ever saw in the Philippines, during a decade of reptile collecting. He assumed that it was a rare snake in Philippine waters.

About 1923 the senior author discovered that the Riu Kiu Island fishermen operating in the Philippines, were catching numbers of *L. semifasciata* and eating them. Those not eaten at once were kept alive in unglazed earthen jars until wanted for food. They obtained them at Monja Island, a reef in the entrance to Manila Bay; at the Capones, off the coast of Zambales Province; from outlying rocks in the Cuyo Islands, and off the Palawan coast; and from the north coast of Bohol and elsewhere in the Visayas.

By 1930 there was an influx of Japanese trawlers in addition to the *muro ami* fishermen already established. Some of the fishermen began to make special efforts to catch sea snakes for two purposes; one, to sell their skins for making leather; two, to sell their flesh for food.

A small snake-skin industry grew up in Manila in the preparation of snake and lizard skins and the making of belts, shoes, purses, ladies bags, cigaret holders, and other articles. The Japanese supplied the skins, but most of their catch went to Japan. Fishing boats came from Okinawa, if not from Japan proper, to the Visayas solely to catch sea snakes, principally *Laticauda semifasciata.*

After a time it was found that Gato, an islet in the Visayan Sea directly north of the island of Cebu, was the breeding place of thousands of sea snakes, belonging to three species. Gato is in the municipality of Daan Bantayan at the north end of Cebu, and Japanese fishermen living there obtained a concession giving them the exclusive right to collect snakes on the islet. In spite of this, poachers continued to come from Formosa and Okinawa to catch sea snakes at various uninhabited isles. The poachers did not kill the snakes, but put them alive into sacks. These were stowed in the hold and taken to Japan in that condition. On several occasions poachers were arrested and found to have a cargo of living snakes, mostly *L. semifasciata.*

The junior author spent considerable time at Gato in the summer months of 1940 and 1941, investigating the biology of the sea snakes there. His purpose was to determine whether the snakes were being exterminated or not, and to see if a proper ratio could be established between the snake population and the catch, so that the industry would be permanent. Officials of the Bureau of Fisheries reported that before the war various Japanese parties obtained from 5,000 to 10,000 skins each. Thus in a single year 20,000 to 30,000 skins may have been taken. During the war all the biological data on the habits, breeding, and life history of these three species of sea snakes, gathered by the junior author, were destroyed. The information following is reconstructed from memory.

Gato has two large caverns that can be entered easily by man during low tide, though their mouths are always under water at high tide. There are also a number of small caves, grottos, and deep crevices in the limestone, which can be entered only through narrow openings or cracks in their walls. Most of these openings are 1 or 2 fathoms under water, and are too narrow to admit a man. The caverns are in total darkness, but are well supplied with air through the many crevices and holes in the roof. By using flashlights and lanterns large numbers of snakes may be seen lying about on the walls and floor of the caves. In small crevices and on roughnesses of the walls lie strings or clusters of white snake eggs.

In June, 1941, the Japanese concessionaire had about 10,000 salted skins ready for shipment. These were the catch for the season and were mostly *Laticauda semifasciata.* By not taking snakes less than a meter in length, it is believed that from 8,000 to 10,000 snakes can be collected every year without diminishing their numbers. While most of the more desirable snakes breed in the large accessible caves, enough more breed in the small

caves and crevices where man can scarcely get at them, to maintain the supply if no more than 10,000 a year are taken at Gato. Thus with proper management, the supply should last indefinitely.

At the present time the Philippine Bureau of Fisheries controls the taking of snakes at Gato. A Filipino concessionaire has been given a monopoly for twenty years. He pays a tax on each kilo of skins ready for shipment.

Snakes that are eaten by the Japanese are spitted on a pointed bamboo. This makes the snake stiff and easy to handle. Most of the snakes are then roasted and smoked, or prepared in the same way as smoked fish. They are usually eaten with soy sauce and various condiments and are then said to be very palatable.

Laticauda colubrina (Schneider) is the longest of the three Gato Island species, but is not nearly so bulky as *L. semifasciata*, and never reaches a large diameter. This snake is able to crawl far above the water line and is found singly in sheltered crevices in the rocks on top of the islet. Leather made from the skin of this snake is very good, but can only be used for small objects as the diameter of the snake is too small. *Laticauda colubrina* occurs in small numbers on Gato, though on some other islets, as on Tailon, off the coast of Camarines Norte Province, many hundreds or even a thousand and more of them may be seen. It is also abundant on some rocky islets of the Sulu Archipelago.

Laticauda semifasciata (Reinwardt), reaching a length of 2 meters, with a circumference equal to a man's forearm, is by far the most abundant snake at Gato. The only descriptions available are of alcoholic specimens and give a false idea of the actual colors of *Laticauda semifasciata*. In life one notes instantly the marked yellow bands alternating with brown or dark brown bands on head, trunk, and tail. The yellow merges on the lower half of the body into the bluish pale or whitish color of the under side. The yellow of *L. semifasciata* is in marked contrast to the gray coloration of the other species of *Laticauda* and of the species of *Hydrophis*.

Laticauda laticaudata (Linnaeus) is common but is too small to be very valuable for leather goods. Its skin is used for trimming material.

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Comparison of Food Habits of *Ensatina eschscholtzii* and *Aneides lugubris*

By Richard G. Zweifel

THE discovery that the plethodont salamanders *Aneides lugubris* (Hallowell) and *Ensatina eschscholtzii* Gray can be found in the same habitat, even under the same piece of cover, opens the way for comparison of the food habits of these species in an area of overlap.

The specimens utilized in this study were collected in Dixie Canyon on the inland (San Fernando Valley) slope of the Santa Monica Mountains, Los Angeles County, California. The habitat is essentially as described by Stebbins (1949: 427), a narrow, north-south canyon in the chaparral, in which black walnut *(Juglans californica)* is the dominant tree.

A total of 45 *Ensatina and* 13 *Aneides* were collected during the winter and spring rainy seasons of the years 1948 and 1949. Most of the collecting was done in the morning hours in an effort to obtain the salamanders while their stomachs were still full from the preceeding evening's feeding. The salamanders were killed within one hour of capture and the stomach contents examined with the aid of a binocular dissecting microscope. The *Ensatina* sample consists of specimens ranging from 23 mm. snout-vent length to 63 mm., with all age groups well represented. The smaller *Aneides* sample is lacking in juveniles, the range being 60-65 mm. snout-vent length.

The principal items of food in more than 20 per cent of the *Ensatina* stomachs examined were: sow bugs (Isopoda) 42 per cent, centipedes (Chilopoda) 42 per cent, spiders (Araneida) 60 per cent, springtails (Collembola: Entomobryidae and Sminthuridae) 47 per cent, and beetles (Coleoptera: Bruchidae, Ptinidae and Carabidae) 36 per cent. Arthropods found in less than 20 per cent of the stomachs included ticks, mites, ants, phalaenid caterpillars, aphids, beetle larvae, pseudoscorpions, earwigs, flies and camel crickets. Absent from this list are millipedes, which have been found in *Ensatina* stomachs by Stebbins (1944) and by Gnaedinger and Reed (1948). The only major difference between the food of the small and large individuals results from the ability of the adults to eat beetles and caterpillars too large for the juveniles. Springtails are perhaps more abundant in the stomachs of the juveniles, but are commonly eaten by the adults.

Items of food occurring in more than 20 per cent of the *Aneides* stomachs were: beetles 77 per cent, phalaenid caterpillars 46 per cent, sow bugs 38 per cent, centipedes 38 per cent and ants 23 per cent. The ants make up a very small amount of the total bulk. With the exception of earwigs and ticks, all food items listed for *Ensatina* were also found in one or more *Aneides* stomachs. A larger sample would most likely include these missing items.

Had some small *Aneides* been available, the differences in the relative numbers of beetles, caterpillars, spiders, and springtails eaten by the two species (see Fig. 1) would probably have been greatly narrowed. Many of the beetles and caterpillars eaten by *Aneides* were too large to have been eaten by any except the largest *Ensatina,* hence the low percentage of these

items in the *Ensatina* sample. Similarly the low percentage of springtails and spiders (many of which were very small) in the *Aneides* sample is likely related to the absence of small *Aneides* that would be more prone to feed on such minute fare. Despite the disparity in size, competition exists even between the smallest *Ensatina* (SV 23 mm.) and the *Aneides*. An *Ensatina* of this size had eaten 2 sow bugs, each 4 mm. in length; sow bugs of this size or smaller were found in 2 of the *Aneides* stomachs.

No evidence of any major seasonal trends in feeding habits could be detected. The arthropods that make up the major food of both salamanders are abundantly present throughout the season of surface activity of the salamanders.

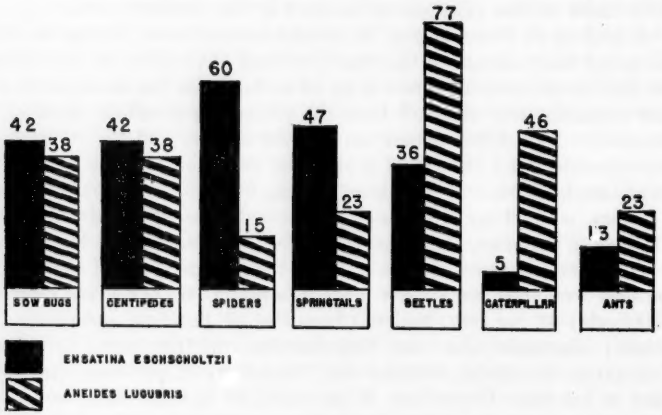

Fig. 1. The relative abundance of various food items in the stomachs of *Ensatina* and *Aneides*. The number above each column represents the percentage of stomachs containing the food item designated.

Plant material was detected in only one stomach *(Ensatina)*. This had evidently escaped from the partially digested abdomen of a camel cricket. No plant material such as the fungus reported by Miller (1944) was noted in the *Aneides* stomachs.

Farner (1947) has demonstrated absence of competition between *Triturus grandulosus mazamae* Myers and *Ambystoma macrodactylum* Baird where they overlap at Crater Lake, and has suggested that the thesis (formulated by Lack, 1946) that two species that feed in the same habitat do not compete for food is applicable to them. The situation in the salamanders studied by myself is just the opposite; Lack's thesis is not applicable in this instance.

Smith (1948) has suggested as a possible corollary that "when two species do feed in the same habitat and do not select different diets, one of the two is strongly dominant over the other." In the type of dominance determined

by relative numbers of individuals of each species present, the salamanders here reported upon fit into this scheme.

Brooks (1948) demonstrated that the relative numbers of 4 overlapping plethodonts, 3 of them congeneric, inhabiting spruce forests, varies with the nature of the habitat. It would be of interest to determine if these salamanders are actually in competition, as seems likely. If this is the case, it might be possible to demonstrate that factors other than competition are primarily responsible for the differences in relative numbers of the salamanders in the various habitats. It is possible that the salamanders studied are occupying a habitat marginal for *Aneides,* and that the dissimilarity in relative numbers of that genus and *Ensatina* is related to habitat preference rather than interspecific competition.

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Herpetological Notes

SKITTERING LOCOMOTION OF THE AFRICAN FROG, *RANA OCCIPITALIS*.—During my stay in French Guinea (Chabanaud, 1921, Bull. Com. Etudes hist. sci. Afrique Occidentale Francaise, 1921: 445–472) I had occasion to observe the peculiar over-water locomotion of *Rana occipitalis* Günther. During the dry season (which is the non-breeding season) this batrachian keeps itself concealed in grass along the borders of ponds and streams. When frightened, instead of diving into the water, this frog dashes across the surface of the water, ricocheting over the surface by striking the water rapidly with its hind limbs. On many occasions my presence scared out frogs of this species and I have observed them crossing at top speed the full breadth of "marigots" some meters wide.

Such skittering locomotion over the surface of the water is well-known in the common Oriental *Rana cyanophlyctis* Schneider (see Annandale, 1919, Rec. Indian Mus., 16: 122), and is reported by Dunn (Amer. Mus. Novit., 315: 5) for the East Indian *Rana macrodon* Kuhl. I was reminded of my West African observations by the recent interesting paper by Richard C. Snyder on the bipedal locomotion of the lizard *Basiliscus*, which is so well-known for its ability to dash across the surface of bodies of water.—PAUL CHABANAUD, *Museum National d'Histoire Naturelle, Paris, France.*

CORAL SNAKE PREYED UPON BY THE BULLFROG.—The bullfrog, *Rana catesbeiana* Shaw, is known to eat a variety of small vertebrates. Frost (1935, COPEIA: 15–18) in examination of 25 specimens reports insects to be the main food in smaller frogs while crayfish, frogs, and mice made up the greater bulk in 4 large frogs. There are several reports of turtles having been eaten by bullfrogs. Snakes have been recorded by a few writers, Wright (1920, Document No. 888, Bureau of Fisheries), Hay (1891, 17th Ann. Rept. Ind. Dept. Geol. Nat. Res.: 479), and Pope (1944, Reptiles and amphibians of the Chicago Area: 118). Usually the species preyed upon is not identified; and there seem to be no records of venomous snakes having been eaten. On the morning of August 6, 1948, I shot a large bullfrog near the Llano River 3 miles east of Llano, Texas. Mr. Lee Behrens, in cleaning the frog, noticed that the stomach was distended and upon opening it found a 17-inch coral snake, *Micrurus fulvius tenere* Baird and Girard. The snake was in an excellent state of preservation and apparently had been swallowed only a few hours previously. Dissection of the coral snake revealed within it a partially digested snake tentatively identified as *Haldea striatula*. The snakes have been preserved in the collection of Dr. Sherman Minton of Indianapolis, Indiana.—JOHN E. MINTON, *New Albany, Indiana.*

ON THE VALIDITY OF *THAMNOPHIS ELEGANS NIGRESCENS* JOHNSON.—In the June issue of COPEIA, 1948, Fitch presented opinions on recent contributions to the literature of *Thamnophis ordinoides* and related species. His conclusion regarding *T. elegans nigrescens* was that the differences separating it from *T. e. vagrans* were insufficient to warrant its recognition. However, no additional information was presented by him. On the other hand, *T. e. nigrescens* was described with full knowledge of Fitch's published information. In addition, a good series of specimens and adequate field work was for the first time available in support of a well differentiated subspecies.

Continued field work has verified the opinion that the differentiation of *T. e. nigrescens* is sufficient to satisfy present exacting herpetological as well as genetic criteria. Granted that such criteria may be merely matters of personal opinion, we believe that opinions based on actual field experience coupled with adequate laboratory analysis should be not disregarded.

Our forthcoming "Reptiles of Washington State" will, we hope, help in showing the valid differences of *T. e. nigrescens* from *T. e. vagrans*.—MURRAY L. JOHNSON and JAMES R. SLATER, *Puget Sound Museum, College of Puget Sound, Tacoma, Washington.*

GOPHER SNAKE KILLED TRYING TO SWALLOW COTTONTAIL.—Snakes occasionally die in attempting to swallow prey that they can not swallow completely. Such was the fate of a California gopher snake (*Pituophis catenifer catenifer*) that was able to swallow only the head of a young cottontail (*Sylvilagus auduboni vallicola*). Presumably, since the snake could not engulf the even larger body, it then tried to disgorge the head but could not spread its own jaws sufficiently. The snake twisted its neck region trying to dislodge the head and the resulting pressure evidently ruptured the skin on both sides of the snake's neck, permitting the rabbit's head to protrude (Fig. 1). There was a 4-inch tear on the left side of the body of the snake and a 2-inch opening on the right side.

Fig. 1. The gopher snake tried to devour a cottontail that was too large to swallow. The neck region of the snake was ruptured when the snake attempted to disgorge the rabbit's head. U. S. Forest Service Photo.

The male gopher snake measured 1,220 mm. from snout to anus and 230 mm. from anus to end of tail. It weighed 365 grams. The young cottontail weighed 97 grams. The dead rabbit was cut free from the mouth of the snake, but the snake was dead on the morning of the fourth day following its discovery. The snake was found by Kenneth A. Wagnon in the morning of July 11, 1948, in the corral at the San Joaquin Experimental Range of the California Forest and Range Experiment Station. No livestock were in the pen.—WALTER E. HOWARD, *Division of Zoology, University of California, San Joaquin Experimental Range, O'Neals, California.*

RECORDS OF REPTILES AND AMPHIBIANS FROM ASSAM.—A collection of 47 specimens of reptiles and amphibians, representing eight species and one subspecies, was made by myself in the Province of Assam, India, when I was stationed in that province with the armed forces in World War II. Although this small collection contains no new material, it seems desirable to place the list of species and subspecies on record.

I observed 4 snakes and 6 lizards, in addition to the specimens included here, that were not captured and therefore not definitely identified. The collection consists of reptiles and amphibians taken and observed in their natural habitat during the months of October, November, and December, 1945, and January, 1946 (the dry season of Assam).

All collecting was done within the boundaries of the District of Lakhumpur. Two snakes (*Eryx johni johni* Russell and *Echis carinatus* Russell) and one lizard (*Uromastix hardwickii* Gray) were obtained from snake charmers. It seems probable that these specimens were not originally collected in Assam, and they are excluded from this list.

Temperature readings were occasionally but not consistently recorded. What records I have are as follows:

September 29, 1945: SHADE, 93.5° F at 11:45 A.M; SUN, 123° F at 3:00 P.M.
November 4, 1945: SHADE, 84° F at 11:50 A.M.; SUN, 100° F at 11:40 A.M.
November 23, 1945: SHADE, 53° F at 6:30 A.M.; SUN, 100° F at 1:00 P.M.
February 20, 1946: SHADE, 65° F at 8:00 A.M.

All specimens remain in my personal possession except 8 frogs deposited in the collections of the Reading Public Museum and indicated in the list by the abbreviation (RPM); and 2 lizards, 1 toad, and 6 frogs donated to the collections of The American Museum of Natural History and indicated in the list by the abbreviation (AMNH).

I wish to express my gratitude to Dr. James A. Oliver, research associate at The American Museum of Natural History and assistant professor of biology at the University of Florida, for identifying the material included in this list; sincere thanks are also due Mr. Charles M. Bogert, curator of reptiles and amphibians at The American Museum of Natural History, and Dr. Marcus Green, assistant professor of biology at Albright College, for supplying various details. Mr. J. C. Arora, of the Research Department of the Government of India Information Services in Washington, D.C., determined the district of Assam in which the collecting localities are located.

SAURIA
(Lizards)

Hemidactylus bowringi (Gray).—Chabua: Sept. 8, 1945 (1, AMNH No. 67611), Sept. 18, 1945 (1).

Hemidactylus brooki Gray.—Chabua: Oct. 1, 1945 (1). This species was observed more often than any other lizard. There were many opportunities to see these lizards crawling up mosquito netting at the sides of tents at night where they sought insects attracted by lights.

Calotes versicolor Daudin.—Chabua: Sept. 12, 1945 (1, AMNH No. 67610), Oct. 17, 1945 (1), Nov. 22, 1945 (1). Collected from small open areas occupied by army installations and native dwellings.

Mabuya macularia (Blyth).—Chabua: Sept. 23, 1945 (1). Collected from open areas at army installations.

SALIENTIA
(Frogs and Toads)

Bufo melanostictus Schneider.—Chabua: Sept. 3, 1945 (1, AMNH No. 53079), Oct. 6, 1945 (1). Collected from very moist habitats at small army installations.

Kaloula pulchra pulchra Gray.—Five miles north of Tinsukia: Jan. 6, 1946 (2, 1 deposited in AMNH, No. 53081). These frogs were found beneath debris in an open field, the location of an abandoned army installation.

Hylorana leptoglossa Cope.—Five miles north of Tinsukia: Jan. 6, 1946 (1, AMNH No. 53080). Collected from beneath debris in an open field, like *Kaloula*.

Rana limnocharis Wiegmann.—Chabua: Sept. 16, 1945, Sept. 18, 1945, Sept. 23, 1945, Sept. 30, 1945 (1 for each date), Oct. 1, 1945 (2), Oct. 5, 1945 (1), Oct. 7, 1945 (2, RPM), Nov. 8, 1945 (2, 1 in RPM), Dec. 2, 1945 (1, AMNH No. 53075); 5 miles north of Tinsukia: Jan. 6, 1946 (1, AMNH No. 53076). Collected from ponds and drainage ditches filled with water; the specimen collected Jan. 6, 1946, was taken from a small stream.

Rana cyanophlyctis Schneider.—Chabua: Dec. 1, 1945 (6, 2 in RPM), Dec. 2, 1945 (2, 1 in AMNH No. 53077); Khowang: Jan. 20, 1946 (13, 3 in RPM, 1 is AMNH No. 53078). This species was found to be the most common frog during December, 1945, and January, 1946. Collected from "tanks" and ponds in open fields.

RICHARD J. BALDAUF, *Mengel Natural History Society, Reading Public Museum, Reading, Pennsylvania.*

A CASE OF SITUS INVERSUS VISCERUM IN *NECTURUS*.—Situs inversus viscerum, or complete visceral transposition, has frequently been reported in man and in fishes, but has been described only a few times among the other vertebrates. It has been produced artificially in amphibians during the experimental production of monozygotic *Triton* twins (Spermann and Falkenburg, 1919, Arch. f. Entw-mech., 45), and by reversing critical parts of the neurula in *Bombinator* and *Rana* (Pressler, 1911, Arch. f. Entw.-mech., 32: 1). However, to the author's knowledge, no cases of its natural occurrence in amphibia have been recorded with the possible exception of a frog alluded to by Mullen (1946, Science, 103: 632) in which "the position of the stomach was reversed from left to right."

The specimen in question is an adult male *Necturus m. maculosus* with a total length, after preservation in formalin, of 240 mm. It is perfectly normal in its external features, but the internal, asymmetrical organs are completely transposed so that the specimen is a mirror image of the normal. The extent of this transposition can be seen in a figure of a cross section (Fig. 1). It will be noted that the liver of the abnormal specimen is on the left instead of the right side as is the postcaval vein and the ligamentum hepatocavopulmonale. The stomach and spleen, together with their associated mesenteries, are on the right. Other asymmetrical organs not shown in the figure are similarly shifted. Thus the gall bladder is on the left, the bile duct enters the duodenum from the left, etc.

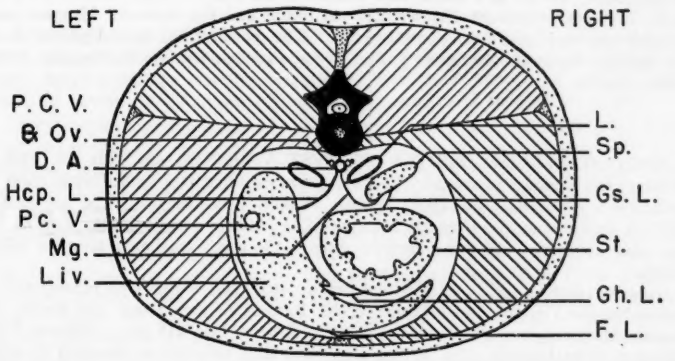

Fig. 1. A cross sectional diagram through the abnormal *Necturus* at the level of the spleen. Posterior view, 2.7 x natural size.
D. A.—dorsal aorta; F. L.—falciform ligament; Gh. L.—gastrohepatic ligament; Gs. L.—gastrosplenic ligament; Hcp. L.—hepatocavopulmonary ligament; L.—lung; Liv.—liver; Mg.—mesogaster; P. C. V. & Ov.—posterior cardinal vein and rudimentary oviduct; Sp.—spleen; St.—stomach.

Little is known about the incidence of situs inversus. It is rather rare in man, but has been found in as many as 4.7 per cent of single individuals of the brook trout, *Salvelinus fontinalis* (Lynn, 1946, Jour. Morph., 79: 1). The incidence is higher in monozygotic twins of the brook trout and other vertebrates than in the general population. It is especially high in conjoined twins. In the human race, the anomaly has been found more often in males than in females, but many believe that this is a result of sociological factors. Data from the lower vertebrates, where such factors would be absent, is unfortunately inconclusive. It may be significant that this specimen of *Necturus* is a male.

The immediate cause of this anomaly is undoubtedly a sinistral rather than a dextral rotation of originally symmetrical organs during development. But the underly-

ing causes of this reversed rotation are not clear. Many, including Newman (1940, Human Biol., 12:21) and Lynn (*l.c.*), believe that it is a sporadic congenital anomaly, but others such as Cockayne (1938, Quart. Jour. Med., 7: 479) feel that it often has a genetic basis. Unfortunately case reports such as this throw little light on these problems.—WARREN F. WALKER, JR., *A. A. Wright Zoological Laboratory, Oberlin College, Oberlin, Ohio.*

THE FLORIDA RED SALAMANDER IN CHARLTON COUNTY, GEORGIA.—Dr. Bishop did not mention Okefenokee localities for *Pseudotriton.* Dr. A. H. Wright (1926, Ecology, 17: 82) listed a *Pseudotriton montanus flavissimus* from the swamp but did not discuss it in detail. A specimen from the Okefenokee originally in the American Museum of Natural History has long since been lost. All the old published records of *Pseudotriton* in the Okefenokee appear to be based on material no longer extant.

On October 31, 1947, I collected a salamander from under some cypress bark and shavings that had been dumped in the Camp Cornelia—Chesser's Island road approximately one-half mile southwest of Camp Cornelia, Charlton County, Georgia, and one-fourth mile from the swamp. The specimen was sent to Dr. Coleman J. Goin, of the University of Florida, for determination, and it proved to be the Florida red salamander *Pseudotriton montanus floridanus,* with 18 costal grooves, the number typical of this subspecies. Dr. Goin states, "that the color pattern is similar to that of many Gainesville specimens. So far as I know, this constitutes the first definite record of this salamander in Georgia, although Dr. Wright's old record and the American Museum specimen now lost, may have been this subspecies." The specimen has been deposited in the U. S. National Museum.—RAYMOND J. FLEETWOOD, *Fish and Wildlife Service, San Antonio, New Mexico.*

THE RED-BELLIED TURTLE IN WEST VIRGINIA.—On July 24, 1946, a *Pseudemys rubriventris rubriventris* (Le Conte) was captured at a hydroelectric plant on the CaCapon River, near CaCapon, Morgan County, West Virginia. The specimen, a male, was deposited in the Carnegie Museum (CM 26630). Measurements were as follows: plastron length, 158 mm.; carapace length, 183 mm.; maximum carapace width, 123 mm.

Ditmars (1936, Reptiles of North America: 405) lists *Pseudemys rubriventris* as occuring "in the Virginias," and Fowler (1925, Records of amphibians and reptiles for Delaware, Maryland, and Virginia, III. Virginia. COPEIA, 146: 67) lists a Harpers Ferry specimen as from Virginia. This animal may have been collected or observed in either Virginia, West Virginia, or Maryland. The Morgan County turtle appears to be the first specimen of this species definitely known to have been collected within the confines of West Virginia.

On May 19, 1948, a female (LWW 375) red-bellied turtle was captured in swift water at the forks of the South Fork of the South Branch, and the South Branch of the Potomac River, near Moorefield, Hardy County. The carapace and plastron of a third specimen were donated by a local sportsman who had shot the turtle about a mile south of Fisher, Hardy County. In recent years the South Branch has changed its course, leaving as a reminder of its former meanderings a series of deep pools and ponds that extend for about 2 miles south of Fisher. This portion of the river is known locally as "the Old River." Recent investigations, after reports from sportsmen, show that a rather large population of these turtles inhabits the larger and deeper ponds of the Old River.—L. WAYNE WILSON, *Moorefield,* and SAUFLEY FRIDDLE, *Leetown Hatchery, Kearnysville, West Virginia.*

RANGE EXTENSIONS FOR TWO WEST TEXAS SNAKES.—Two rather rare snakes were collected by Homer W. Phillips and myself during a trip through eastern Trans-Pecos Texas. These were an *Elaphe subocularis* (Brown) and an *Agkistrodon contortrix pictigaster* Gloyd and Conant. William W. Milstead collected another specimen of the latter species later in the summer and has made it available to me.

Elaphe subocularis was first described from the Davis Mountains (Brown, 1901, Proc. Acad. Nat. Sci. Phila., 53: 492–95) and has since been reported from near El Paso (Schmidt, 1925, Copeia: 87), from the Chisos Mountains (Schmidt and Smith, 1944, Field Mus. Nat. Hist., Zool. Ser., 29: 75–96), and from the Sierra Vieja Mountains (Jameson and Flury, Tex. Jour. Sci., 1, No. 2: 54–79), Texas; from Coahuila, Mexico (Smith, 1939, Ann. Carn. Mus., 27: 311–320, and Schmidt and Owens, 1944, Field Mus. Nat. Hist., Zool. Ser., 29: 97–115); and from the Organ Mountains of New Mexico (Lewis, 1948, Herpetologica, 4: 223). The present specimen (Univ. of Texas Nat. Hist. Coll. No. T4771) was found D.O.R. 12.5 miles west of Comstock, Val Verde County, Texas, in the late afternoon of June 2, 1948. This represents a range extension of about 175 miles east south-east of the type locality and of about 190 miles north north-east of Cuatro Cienegas, Coahuila, the two closest previously reported localities. The specimen is a young male with a total length of 532 mm. and a tail length of 70 mm. The dorsal scale rows are 33–35–23. There are 278 ventrals and 73 pairs of subcaudals. There are 22 H-shaped blotches on the body and 8 similar blotches on the tail. Scutellation and coloration are in accord with the range of variation of reported specimens. It may be noted here that the Organ Mountains specimen was reported to have 207 ventrals, while the minimum number otherwise reported was "about 240" (Brown), with an average (for 19 exactly reported specimens) of 271.6. The numbers of ventrals are 264–277 (av. 270.4) in 7 females and 266–281 (av. 272.5) in 11 males, supporting Schmidt and Smith's (1944) conclusion that this character does not show sexual dimorphism in *Elaphe subocularis*. More specimens are needed, especially from New Mexico, to explain the low number of ventrals in the Organ Mountains specimen and in Brown's paratypes.

Agkistrodon contortrix pictigaster Gloyd and Conant (1943, Bull. Chi. Acad. Sci., 7: 147–170) has been reported only from the two localities of the type series: the Chisos Mountains, in Brewster County, and near Mitre Peak, in southern Jeff Davis County, Texas. On June 3, 1948, Mr. Phillips and I found a single specimen of this form that had been killed in the yard of a home in Sanderson, Terrell County, Texas. The homeowner was kind enough to let us have the animal and it is now U. T. N. H. C. No. T4774. This represents a range extension of about 85 miles northeast of the type locality and about the same distance a little south of east from Mitre Peak. The specimen agrees generally with the original description. It is an adult male with a total length of about 457 mm., tail 71 mm. There are 148 ventrals and 55 subcaudals, the first and the posterior 25 subcaudals being divided. On the right side, the two anteriormost suboculars are fused to form a single scale. Supralabials number 8, infralabials 9–10. The dorsal scales are in 27–23–19 rows. Coloration is similar to that of the type but badly faded in formalin. There are about 14 dark bands on the body and 3 on the anterior half of the tail, the posterior half being too faded to show bands.

Mr. Milstead's specimen (WWM No. 659) is another male, caught August 30, 1948, 2.4 miles northwest of Ft. Davis in Limpia Canyon. This is about 10 miles northwest of the Mitre Peak locality. The total length of this specimen is 501 mm., tail 76 mm. There are 147 ventrals and 53 subcaudals, the posterior 15 being divided. The terminal spine is large and claw shaped, not retracted into the subcaudals. On the left side the two anteriormost suboculars are fused. Supralabials number 8, infralabials 10. The dorsal scales are in 23–21–19 rows. Coloration is as in the type, with 14 dark bands on the body and 3 on the anterior one-third of the tail. It seems reasonable to expect this snake to be present in the larger canyons of most of southern Trans-Pecos Texas.—Alvin G. Flury, *Dept. of Zoology, University of Texas, Austin, Texas.*

NOTES ON THE COITION AND FEEDING OF THE BLUE-TAILED SKINK.—Some years ago I kept a number of skinks, *Eumeces fasciatus* (Linnaeus), from a woods in Warren Township, Section 7, Marion Co., Indiana, in a 12 x 14 x 16 inch cage with wooden bottom, screen sides, and a glass lid, for the observation of their habits. The cage was bare aside from sparse litter and a water-pan. Since the lizards were caught a few at a time, I learned to recognize the individuals and they were given number names. For a time detailed records were made of the proceedings within the cage, including the following notes on coition-frequency and feeding.

COITIONS—The below-listed copulations were seen over a period of eight days, but probably not all that occurred were seen. Female No. 10, on May 23, 1937, was the last addition to the cage; the first coition was noted the next day. The coitions noted are as follows: May 24, female No. 1 was twice copulated by male No. 8, and once by male No. 6, and was twice caught but without coition by male No. 5. This female was copulated three times by two males in one day, but was not again noted in coitus. Female No. 2 was copulated by male No. 5. Female No. 9 was caught twice by male No. 5 but only copulated once. Female No. 10 was copulated by male No. 8. As to the males, No. 5 was twice in effective coition; No. 6 once; and No. 8 three times.

May 27, female No. 9 copulated with male No. 8.

May 29, female No. 9 copulated with male No. 5; and female No. 10 was in coitus with male No. 6.

May 30, female No. 2 was in coitus with males Nos. 5, 6, and 8. Female No. 3 was noted in coitus for the first time and with male No. 5. Each of the males thus was noted in coition, and No. 5 twice.

May 31, female No. 2 copulated with male No. 8; female No. 10 was also copulated by male No. 8; and female No. 9 was copulated by male No. 5. Only two males were active, but one (No. 8) copulated twice.

In summary, female No. 1 was in coitus three times; No. 2 five times; No. 3 once; No. 9 four times; and No. 10 three times. As to males, No. 5 was in coitus six times; No. 6 thrice; and No. 8 seven times. It is apparent that the greatest coitus-frequency was three per day, but the data are too few to yield useful averages. Promiscuity clearly prevailed. Coitus between males was not noted.

A seemingly important, constant detail of the copulation process was noted. During coition the tail of the female is arched upward while below, the arched tail of the male is pumped up-and-down without involving the hips. During the tail-pumping an audible clicking noise is produced. This sound was found to result from the tail-movements alternately opening and closing a small, posterior, cloacal orifice. Within seconds after being freed from coition, females were noted to rub the cloacal lips against the substratum and to emit a drop or so of a whitish or pinkish tinted, bubble-containing fluid from the cloaca. This was a constantly observed post-coitus ritual. My interpretation is that the tail-pumping process forces air into the cloaca at the posterior orifice as bubbles which, when the lizard is disengaged, are at least partially emitted to form the observed bubble-containing fluid. Are the air-bubbles important in conveying the sperm upwards into the female's cloaca?

FEEDING HABITS.—The captive lizards were fed mostly field-crickets *(Gryllus)* of which the large lizards could eat the adults. Various sizes being ordinarily present in the food offered, a small lizard would sometimes seize a large, almost non-ingestible cricket. On several such instances the lizard broke off the large rear legs of the insect. This might occur prior or subsequent to the effort to swallow the cricket. The lizards tended to grab the crickets by the pronotum; the seized crickets, in defense, thrust the cerci, legs, and spiny tibia against the head and eyes of the lizard, which tries to work its hold forward and to chew the head of the insect vigorously, thus disabling it.

On one occasion a group of lizards (collected the day before) were offered newly hatched young (less than 5 mm. in diameter) of a sometimes destructive foreign snail, *Helix aspersa* Müller. The adult lizards were seen to catch, masticate, and to swallow the snails that moved. However, one immature lizard (longer adjusted to captivity) found and swallowed a quiescent snail after a few preliminary licks of the tongue. The snail apparently had been identified as edible by smell or taste, but the lizard's bite was too weak to crush the thin shell.—GLENN R. WEBB, *University of Illinois, Urbana, Illinois.*

THE RED MILK SNAKE, *LAMPROPELTIS DOLIATA SYSPILA*, IN NEBRASKA.—On March 20, 1948, the authors collected a male red milk snake, ***Lampropeltis doliata syspila*** Cope,[1] in the forested Missouri River bluff region, 2 miles south and 3 miles east of Rulo, Richardson County, southeastern Nebraska. It was beneath rocks at the opening of a 30-foot, partially covered well. This well evidently served as a hibernating place for the milk snake, two blue racers, ***Coluber constrictor flaviventris,*** and three pilot black snakes, ***Elaphe obsoleta obsoleta.*** Other snakes may have been present, since the rock wall was investigated to a depth of only 3 feet. The outside air temperature at the time of discovery, 3:00 P.M., was approximately 70° F.

This milk snake has a dorsal body pattern of 26 red, black-bordered, saddle-like blotches that extend to the second scale row. These blotches are separated by twenty-five whitish bands, usually three scales wide dorsally, but expanded laterally. On the side, alternating with the dorsal blotches, is a series of small black blotches, which extend onto the ventral scutes. The ventrals are covered with small quadrangular bloches of black and white. The blotches on the tail are replaced by seven rings that completely encircle it. The head has a narrow black band across the posterior edge of the parietals, bordered posteriorly by a narrow whitish dorsal collar. Anterior to the black parietal band and extending to the prefrontals, the head has a red blotch. There are two white, black-bordered superciliary spots. The snout is whitish, flecked with black. A black line extends from the eye to the angle of the mouth.

The scale characters are as follows: supralabials 7–7, eye bordering 3rd and 4th on each side; infralabials 9–9; preoculars 1–1; postoculars 2–2; temporals 2+3, 2+2; scale rows 19–21–19; ventrals 202; caudals 52. Total length 652 mm., tail 99 mm. The specimen is in the authors' collection.

This appears to be the first definite report of this subspecies from Nebraska, although *Lampropeltis doliata gentilis* and its intergrades with *L. d. syspila* have been reported from the state by G. E. Hudson (1942, The amphibians and reptiles of Nebraska, Nebr. Conservation Bull., 24). W. E. Taylor (1892, The Ophidia of Nebraska, Nebr. State Board Agric.) listed specimens from Red Willow, Cuming, and Nemaha counties under the name *Ophibolus triangulus* var. *doliatus* Baird and Girard. His excellent description was probably based upon both *gentilis* and *syspila,* but unfortunately subspecific allocations cannot be verified since the specimens are no longer in existence. A single specimen (Univ. Nebr. State Museum, 1568) from Humboldt, in western Richardson County, appears to have pattern characteristics of both subspecies, and is intermediate in having the head predominantly black, with a small amount of reddish coloration on the anterior parts of the parietals and extending over the frontal. It approaches *syspila* in that the dorsal blotches fail to reach the ventrals on the anterior portion of the body while the posterior part of the body has the extension of the dorsal blotches onto the ventrals and the absence of small lateral blotches, as in *gentilis.* Examples from Cass and Sarpy counties to the north are also considered to be intergrades. All specimens from western Iowa and Missouri have been referred to *syspila,* as have specimens from eastern Kansas. Thus the range of the typical red milk snake ***Lampropeltis doliata syspila*** Cope, in Nebraska can be stated as: the forested Missouri River bluff region of southeastern Richardson County, and probably north along the river into Nemaha (Taylor, 1892), and Otoe counties.—RICHARD B. LOOMIS, *Museum of Natural History, Lawrence, Kansas,* and J. KNOX JONES, JR., *Nebraska Game, Forestation and Parks Commission, Lincoln, Nebraska.*

[1] See Klauber (1948, COPEIA, 1948: 10) for use of *doliata* for *triangulum.*

Ichthyological Notes

ON THE TAXONOMY AND THE POSTLARVAL STAGES OF THE SURGEONFISH, *ACANTHURUS HEPATUS*.—In the process of working up a collection of West Indian marine fishes, Breder (1925, Bull. Bingham Oceanogr. Coll., 1 (1): 1–90) could not reconcile an obvious postlarval acanthurid with any known West Indian species. The material was described from Glover Reef specimens, off Yucatan, under the name *Hepatus pawnee* [= *Acanthurus pawnee*]. Parr (1927, Bull. Bingham Oceanogr. Coll., 3 (4): 1–148) obtained more examples from Nassau, B. W. I., without attempting to recognize the form as the young of a known adult species. Longley and Hildebrand (1941, Carn. Inst. Wash. Publ., No. 535: 1–331) synonymized the form with *A. hepatus* (Linnaeus). Breder (1948, Bull Amer. Mus. Nat. Hist., 92 (5): 281–312) questioned this action for the reasons which originally led him to give a name to the form.

It has been established beyond any doubt that Longley and Hildebrand were right in considering this form a stage in the development of *Acanthurus hepatus*. This conclusion was reached while doing some other work at the Lerner Marine Laboratory at Bimini, B. W. I., during mid-April, 1949. In addition to the striking differences, the original disbelief that these two forms could be the same species was based primarily on the fact that numbers of typical *A. hepatus* can be taken at sizes very considerably smaller than the largest of the *pawnee* stage. The reasons for this apparent contradiction are to be found in an interesting peculiarity of the juvenile behavior and its influence on morphology.

Young fishes in the *pawnee* stage may be taken in the open sea at night with a submerged light acting as an attractant. In fact, so far as the author is aware, most if not all of the known specimens have been so taken. As noted by Parr, they are perfectly transparent in life except for the markedly silvery peritoneum and the eyes. Dark pigment about the head, as noted by Breder (1925, see above), is not apparent in the living state. Outside of the harbor entrance at Bimini they were taken in company with various other transparent fishes such as a variety of leptocephalids, the young of *Synodus*, et cetera. The latter, as described by Breder (1944, Zoologica, 29 (3); 13–16), if confined in a tank continues its pelagic type of behavior until it is ready to transform when it quickly settles to the bottom and takes on the adult characteristics. The transparent young of *A. hepatus* however, when placed in an aquarium, immediately seek the shelter of shells and begin their transformation at once. This is independent of the exact size of the fish within the limits observed, one example transforming at 23 and another at 29 mm. in standard length. The type specimen was 26.5 mm. Breder (1948, see above) reported individuals from the tide pools of Bimini from about 10 to 20 mm. in standard length, which closely resembled adults and gave no suggestion of what was evidently a recent transformation. The complete transformation, as observed, occurred in a period of about 48 hours.

Inferentially what takes place in the state of nature is that the transparent young fish drift in the sea as a part of the plankton. When they reach a certain stage of development they continue to grow in that condition so long as they are drifting in open water. When vagaries of current carry them inshore or close to the bottom they then immediately change their habits and seek the shelter of solid objects, rapidly changing their behavior and coloration to that of miniature adults. Such a procedure, which actually was observed in aquaria, accounts nicely for the finding of some individuals of a larger size in the transparent planktonic stage while others of a smaller size are encountered in rocky places and bear a close resemblance to the adults. How long they can remain in the planktonic transparent stage or what size they may attain if they do not reach shore promptly is of course unknown. How much foreshortened the transparent stage may become is likewise uncertain but it is clear that the transformation can take place at something less than 10 mm. in standard length.—C. M. BREDER, JR., *The American Museum of Natural History, New York 24, New York.*

NOTES ON THE KOKANEE *(ONCORHYNCHUS NERKA KENNERLYI).*—The kokanee, also commonly known as the silver trout, little redfish, land-locked sockeye, and "yank," closely resembles the sockeye salmon *(Oncorhynchus n. nerka)* in appearance, except for its small size and its normal habit of confining its life to freshwater. Kokanees are abundant in many of the lakes of the Pacific Northwest and British Columbia, occurring naturally in many of them and having been introduced into others. Within the past few years, some have also been planted in Maine lakes to provide fresh-water angling.

Although for several decades this fresh-water fish has generally aroused the curiosity of salmon investigators along the Pacific Coast, there has been surprisingly little published information on its biology. Schultz and students (1935, Mid. Pac. Mag., Pan-Pac. Res. Inst. Sec., Jan.-Mar.: 67–77) presented observations on the spawning habits and morphometric differences between the sexes of the species. Ricker (1938, Jour. Fish. Res. Bd. Can., 4 (3): 192–218, and 1940, Trans. Roy. Soc. Can., 3rd ser., 34 (5): 121–135) mentioned the possible competition between the kokanee and the lacustrine stages of the anadromous sockeye and discussed the possible origin of the kokanee. Foerster (1947, Jour. Fish. Res. Bd. Can., 7 (2): 88–93) described an abortive attempt to develop a sea-run sockeye population from transplantations of the land-locked kokanee into streams emptying into the ocean. Curtis and Fraser (1948, Cal. Fish. Game, 34 (3): 111–114) reported several successful plantings of this species into California lakes. The above few papers seem to be the main contributions towards a study of this species.

I realize that there is a great deal more existing information about the kokanee than appears in the scientific literature. The fisheries investigators in the Northeast Pacific region have made intensive studies of the various species of Pacific salmons *(Oncorhynchus)* and are in possession of much unpublished data concerning this land-locked sockeye. The fish and game departments of the Pacific states have propagated the kokanee as a game fish for many years and must have many observations on the life histories and abundance of this species. It is hoped that the following brief notes may possibly stimulate the appearance of further published facts. At the present time, the results of innumerable experiments and extensive studies, both on kokanees and the other salmons, are unknown except to those intimately concerned with the work.

In 1937, I began a study of the life history of the landlocked sockeye in Washington State. Considerable data had been collected by 1938, when I was transferred to Maine. An example of the danger of procrastination in publishing biological information is evident in my subsequent loss of a great deal of the original and copied data during one of my numerous moves in the past decade. The only information now in my possession concerns the length frequencies and fecundity of two lots of spawning kokanees, one of which I collected October 2, 1938, at North Bear Creek, King County, Washington State and the other from the late W. C. Kendall's collection made at Kootenay Lake, British Columbia, on August 13, 1898.

The North Bear Creek sample consisted of 103 females and 97 males. Standard lengths of these were obtained, together with numerous morphometric measurements. Standard length, as I measured it, was the distance between the posterior margin of the hypural plates and the tip of the snout or jaw, whichever protruded. For the females, the range in length was 224 to 268 mm.; the mean length, 248.2 mm.; and the standard deviation of the mean, 9.53 mm. For the males, the range was 231 to 274 mm.; the mean length, 256.7 mm.; and the standard deviation of the mean, 10.18 mm. When the lengths of the two sexes are compared, one obtains a t value of 6.11 with 198 *d. f.*, which results in a P of less than 0.01, thus indicating that a significant difference exists between the lengths of male and female kokanees. The five females from Kootenay Lake had a length range of 203 to 213 mm.; a mean length of 207.8 mm.; and a standard deviation of the mean of 3.87 mm. The males ranged from 201 to 231 mm.; and had a mean length of 214.6 mm.; and a standard deviation of the mean of 8.08 mm. The Kootenay Lake males were 3.3 per cent longer than the females while North Bear Creek males exceeded the females by 3.4 per cent. No significant difference in length existed between the Kootenay Lake males and females; however, this sample was quite small.

There were 23 North Bear Creek females whose eggs were not quite ripe—at least two more weeks would have had to elapse before their being extruded. The number of eggs per female ranged from 319 to 592, with a mean count of 451.9 and a standard deviation of the mean of 51.19. Curtis and Fraser *(loc. cit.)* stated that 626 mature females at the Salt Springs, California, area yielded 300,000 eggs for an average of 479.2 eggs per individual. Their fish were slightly larger than the North Bear Creek specimens and this may have accounted for the greater average egg count. In the only two Kootenay females with eggs one had 360 and the other 375 eggs.—LESLIE W. SCATTERGOOD, *U. S. Fish and Wildlife Service, Boothbay Harbor, Maine.*

SIMILARITY IN THE RETINAE OF *AMPHIODON ALOSOIDES* AND *HIODON TERGISUS*.[1]—The goldeye, *Amphiodon alosoides* (Rafinesque), was placed in the genus *Hiodon* LeSueur by Jordan and Evermann (1896, Bull. U. S. Nat. Mus., 47 (1): 1–1240); and later Jordan, Evermann and Clark (1930, Rept. U. S. Comm. Fish., 1928 (2): 1–670) placed the form again in *Amphiodon*, where it has since remained for most writers. The purpose of the present note is to present evidence that in eye structure *Amphiodon* is not generically distinct from *Hiodon*. Moore (1944, Jour. Comp. Neurol., 80 (3): 369–379) showed the presence of a guanine tapetum and the absence of cones in the retina of *Hiodon tergisus* LeSueur, and, since *Amphiodon alosoides* is obviously very closely related, it seemed highly probable that the eyes of the two forms should be similar.

The material for this study was obtained from Lake Texoma, an artificial impoundment on the Red River near Denison, Texas. The eyes were fixed in Perenyi's fluid, sectioned in celloidin and stained with Heidenhain's iron hematoxylin with ploxine as a counterstain. Sections of *Hiodon* eyes used by Moore *(loc. cit.)* were available for comparison, and the measurements of myoid bases are from that paper.

It would appear from this study that, in so far as the retinae are concerned, *Amphiodon* and *Hiodon* are not generically distinct. Both have pure rod retinae, a guanine tapetum lucidum, and almost identical measurements of visual cell structures.

It is quite probable that in taking measurements in sections one might measure a fragment and think that the whole structure was present. If, in Table I, the maxima are examined, a greater similarity than is indicated in the averages is evident.

TABLE I

COMPARATIVE MEASUREMENTS IN MICRONS OF ROD STRUCTURES IN THE RETINAE OF *Amphiodon alosoides* AND *Hiodon tergisus*

	Amphiodon			*Hiodon*		
	Average	Range	Number	Average	Range	Number
Base of myoid	4.3	3.7–5.4	11	4.3	3.7–5.0	6
Width of ellipsoid	3.4	3.0–3.8	16	3.0	2.4–3.6	8
Length of ellipsoid	5.6	4.1–6.9	9	5.9	4.6–7.1	9
Width of outer segment	2.2	1.9–3.0	14	2.3	1.9–3.0	12
Length of outer segment	32.5	29–38	9	37.1	30.1–43	8

In all respects, except the length of the outer segment, there is less than 0.5 micron difference between the visual cell structures of the two forms. The outer segments in *Hiodon* are maximally 5 microns longer than in *Amphiodon*. Although this is surely significant, it is not greater than could be expected between species of the same genus.

We feel that a careful comparison of the two forms will, in all probability, indicate that *Amphiodon* is congeneric with *Hiodon*.—GEORGE A. MOORE and ROYCE C. MCDOUGAL, *Oklahoma A and M College, Stillwater, Oklahoma.*

[1] Contribution No. 150 from the Department of Zoology and the Research Foundation of the Oklahoma Agricultural and Mechanical College. The writers are indebted to Dr. Carl Riggs, of the University of Oklahoma, who supplied the *Amphiodon* eyes.

UNUSUAL OCCURRENCE OF FISH ON NEW ENGLAND BANKS.—During cruises of the Fish and Wildlife Service research vessel *Albatross III* on the New England Fishing Banks in 1948, a number of fish were trawled that were worthy of note, either by comparative rarity or by being found beyond their previously determined range limits. Aid in identification of several species was courteously given by the late Dr. Samuel F. Hildebrand, of the Fish and Wildlife Service, Washington, D. C., and by William C. Schroeder, of the Museum of Comparative Zoology, Harvard University, and the Woods Hole Oceanographic Institution.

1. *Alutera ventralis* Longley; file fish or fool fish.—One specimen was taken October 30, 1948, in 46 fathoms, about 50 miles south of No Man's Land (40° 19′ N 70° 43′ W). The species is a rarity in these latitudes. It has previously been reported and described from the Tortugas region by Longley, but no other records were found. The *Albatross III* specimen measured 160 mm. to the base of the caudal, with a depth of 82 mm. Longley's largest fish was only 100 mm. to the base of its caudal.

2. *Dibranchus atlanticus* Peters; bat fish.—Twelve bat fish were caught October 30, 1948, in 64 fathoms, location 40° 60′ N, 70° 33′ W. The largest specimen was 151 mm. in total length, the smallest 110 mm. with an average total length of 133 mm. This species usually is found at much greater depths although a few specimens have been trawled in less than 100 fathoms in semi-tropical localities.

3. *Scyliorhinus retifer* (Garman); cat or marbled shark.—Seemingly rare because they are found in depths infrequently fished, 7 cat sharks were taken October 28-29, 1948, during three tows in the following depths and locations:

No. Caught	Depth	Location
1	38 fms.	40° 34′ N, 70° 58′ W
4	46 fms.	40° 23′ N, 71° 05′ W
2	86 fms.	39° 53′ N, 71° 59′ W

The largest *Albatross III* specimen was 440 mm. total length (male), the smallest was 330 mm. (female), while the average total length was 392 mm. Specimens included 5 males and two females.

4. *Raja ornata* Garman; skate.—This species is a tropical straggler, primarily of moderately deep-water habitat. One specimen was caught November 1, 1948, off Long Island (40° 18′ N, 73° 24′ W) in 14 fathoms. Total length was 421 mm., and it measured 22 mm. across the wings.

5. *Triglops ommatistius* Gilbert; mailed sculpin.—Two specimens, total lengths 102 mm. and 114 mm., were trawled July 17, 1948, in 45 fathoms on Georges Bank, location 40° 48′ N, 66° 31′ W. Mailed sculpins are undoubtedly more numerous than their catch records suggest, since they are able to pass through the meshes of common otter trawls. They have been taken from time to time at scattered points throughout the Gulf of Maine and Georges Bank in the past 50 years.

6. *Melanogrammus aeglifinus* Linnaeus; haddock.—Of special interest to the current haddock investigation was the trawling of nearly 800 baby haddock less than one year old on November 1, 1948, in 14–17 fathoms, 10 miles south of Ambrose Lightship, and in 12 fathoms off Fire Island Inlet, L. I. Existence of haddock nursery grounds was not suspected this far to the south and west, for the accepted limit was slightly westward of the Nantucket Shoals region.

7. *Prionace glauca* (Linnaeus); great blue shark.—Neither rare nor out of range limit, this species has been included because the 11 caught by hand-lining from the *Albatross III* were all males, substantiating the observations of Bigelow and Schroeder in "Fishes of the Western North Atlantic," in which they found that all but 2 of 20 specimens were males. The *Albatross III* specimens averaged 9 feet in length and were caught from mid-July to September.

8. *Selar crumenophthalmus* (Bloch); big-eyed scad.—A tropical straggler, one specimen was taken September 23, 1948, from the Fish and Wildlife Service dock at Woods Hole during angling for young bluefish *(Pomatomus saltatrix)*. The fish was 158 mm. long, measured to fork of tail.

9. *Cephalacanthus volitans* (Linnaeus); the flying gurnard.—This fish is listed in "Fishes of Chesapeake Bay" by Hildebrand and Schroeder, and in Breder's "Marine

Fishes of the Atlantic Coast Field Book," as a warm water species, rare north of North Carolina, with occasional strays to Cape Cod (presumably in summer). Two specimens, however, were caught November 24, 1948, from the deck of the *Albatross III,* moored to the Woods Hole dock. These fish were 152 mm. in length, measured to the fork of tail, and were taken while they were swimming at the surface among schools of whiting (*Merluccius bilinearis*).—EDGAR L. ARNOLD, JR., *U. S. Fish and Wildlife Service, Woods Hole, Massachusetts.*

NOTES ON A COLLECTION OF FRESH-WATER FISHES FROM TRINIDAD.—The collections of the Trinidad Zoological Expedition of the Chicago Natural History Museum, conducted by Mr. F. C. Wonder in the early part of 1947, include about one-third of the species of fresh-water fishes known from that island (Regan, 1906, Proc. Zool. Soc. London, 1906: 378–393; Fowler, 1931, Proc. Acad. Nat. Sci. Phila., 83: 391–410). Of especial interest is a small series of *Roeboides dayi* Steindachner, the first recorded occurrence of the genus on Trinidad. Five were collected at Brickfield and 2 on Mt. Harris. These agree in scale count with *R. dayi dientonito* Schultz, of Venezuela, but differ somewhat in fin-ray counts. The tabulation that follows compares the type series of *dientonito* (Schultz, 1944, Proc. U. S. Nat. Mus., 95: 306) with the 7 from Trinidad. Simple and branched rays are combined in the fin counts. It was not possible to make counts for all of the Trinidad material.

	Anal rays							Dorsal rays			Pelvic rays		Pectoral rays				
	46	47	48	49	50	51	52	9	10	11	8	9	12	12	14	15	16
dientonito	2	2	8	3	6	2	1			6	10				6	3	1
Trinidad				2	3	1		1	3	2	1	4	1	2	2		

	Lateral line scales						
	53	54	55	56	57	58	59
dientonito	1	3	5	5	3	2	1
Trinidad			1	2	1		

Without additional specimens from Trinidad and in the absence of material from Rio Magdalena, Colombia, the type locality of *dayi,* further comment on the taxonomic status of the Trinidad population is withheld.

Also included in the collections made by Mr. Wonder are 13 specimens of *Plecostomus plecostomus* Linnaeus, 5 from Brickfield and 8 from San Rafael. These provide an opportunity to examine the status of *Plecostomus robini* Cuvier and Valenciennes, type locality Trinidad. The original description of *robini* (1840, Hist. Nat. Poiss., 15: 501–Strassbourg ed., 15: 370) attributed only one row of brown spots to each interval between dorsal fin rays. Three of our specimens have the dorsal spots arranged in single rows; the spots are disposed in two rows in the others. In his monograph of the Loricariidae, Regan (1904, Trans. Zool. Soc. London, 17: 203) distinguished between *plecostomus* (or as he called it, *guacari* Lacépède) and *robini* on the basis of the length of the mandibular ramus relative to the interorbital width. According to Regan the ratio of the two measurements is 3 in *plecostomus* and 2 in *robini.* It should be pointed out that Regan had available only 2 specimens of the latter, the type and an individual from Montevideo. In our series the ratio varies from 2.0 to 3.3. Later, Regan (1906, Proc. Zool. Soc. London, 1906: 380) gave as the diagnoses of these two forms: eye moderate, snout ovate *(plecostomus);* and eye small, snout broadly rounded *(robini).* Our series indicates that these characters, taken singly or together, do not serve to distinguish between the two forms. In snout shape there is a complete gradation from broadly rounded to ovate and pointed. Similarly there is no possible dichotomy based on eye size. Instead there is an inverse relationship between the size of the eye and standard length. Furthermore all of the supposedly diagnostic characters—spots on the dorsal, snout shape, mandibular length, and eye size—are distributed at random with respect to one another. Thus there is no evidence that two populations of *Plecostomus* can be recognized on Trinidad. *Plecostomus robini* Cuvier and Valenciennes should be placed in the synonymy of *Plecostomus plecostomus* Linnaeus.—ROBERT F. INGER, *Chicago Natural History Museum, Chicago, Illinois.*

DOES THE SPANISH MACKEREL, *SCOMBEROMORUS MACULATUS* (MITCHILL), OCCUR THROUGHOUT THE WEST INDIES?—Three closely related species, *Scomberomorus maculatus, S. regalis* and *S. cavalla,* occur together in the coastal waters of Florida, straggling north to Cape Cod. All three species have been recorded from the West Indies; such records for *S. maculatus* are open to doubt, with the probable exception of Cuba. Both Luis Howell Rivero and Luis Rene Rivas, Cuban ichthyologists, have told me in conversation that *S. maculatus* occurs commonly in Cuba.

From December, 1944, to May, 1946, I was in Puerto Rico and also made a 5-month sailing cruise through the Lesser Antilles as far south as the Grenadines and through the Greater Antilles excepting Jamaica. Special attention was paid to the species of *Scomberomorus* which we caught by trolling, and also to those in the catches of commercial fishermen. *S. regalis* was noted frequently, *S cavalla* occasionally, but no *S. maculatus* were seen. My observations are supported further by recent detailed studies by Isaac Ginsburg, of the U. S. Fish and Wildlife Service, who found authentic specimens of *S. maculatus* in the National Museum only from the east coast and Gulf coast of the United States, Panama, and Venezuela. All specimens from the West Indies labeled *S. maculatus* by previous authors were wrongly identified. I tentatively conclude that the geographical distribution of the Spanish mackerel is confined to the coastal areas of the American continents, probably including the north coast of Cuba. Should any specimens of *S. maculatus* be collected from the West Indies, especially Cuba and Hispaniola, I would be pleased to have the opportunity of studying them.

The following key, based primarily on color characters, is intended to aid in distinguishing the adults of the three species in the field. To the late Dr. S. F. Hildebrand and to Luis R. Rivas I am indebted for certain information used.

1a. Lateral line abruptly descending below second dorsal fin; bronze spotting on sides absent or indistinct; no black color on first dorsal fin; gill rakers on lower limb of first gill arch 7 to 9 ..... *S. cavalla*

1b. Lateral line gradually descending below second dorsal fin; bronze spotting conspicuous; black color on first dorsal fin; gill rakers on lower limb of first gill arch 9 to 13.

2a. Fine bronze spotting arranged in regular rows, those along the middle of each side in the form of elongate rectangular blotches; black color on first dorsal fin not reaching base of fin; pectorals scaled; gill rakers 12 to 13 ..... *S. regalis*

2b. Prominent round bronze spots irregularly arranged on sides; black color on first dorsal reaching base of fin; pectorals scaleless; gill rakers 9 to 12 ..... *S. maculatus*

DONALD S. ERDMAN, U. S. National Museum, Washington 25, D. C.

REVIEWS AND COMMENTS

METHODS OF COLLECTING AND PRESERVING VERTEBRATE ANIMALS. By Rudolph Martin Anderson. Canada Dept. of Mines and Resources, Nat. Museum of Canada, Ottawa, Bull. 69, Biol. Ser. 18, 1949: i–iv + 162 pp., 48 figs., 2nd ed. rev. Paper 50c, cloth $1.00.—An excellent manual for the field worker, including a chapter on the general principles of zoological collecting and a comprehensive reference list. Most of the text is given over to the preparation of mammal and bird specimens; Chapter V, on the collection and preservation of reptiles, amphibians and fishes, and Chapter VI, on the collection and preparation of skeletons, will prove of interest to ichthyologists and herpetologists.

A GUIDE TO MARKETABLE FISH. By R. J. Daniel, D.Sc. Obtainable from the Author: Department of Oceanography, The University, Liverpool 3. No date. 68 pp., 13 figs. X plates. 3/— (including postage).—This little pamphlet contains seven chapters, covering such topics as fishing grounds and methods of fishing, types of commercial fish and shellfish, diseases, parasites and staleness in marketable marine animals, and preservation of fish.

Daniel's "Guide" is written for members of the fishing industry and laymen in Great Britain. For the non-specialist in this country the outline drawings of marketable fish and the criteria for staleness in fishery products, not to mention other bits of information, are of interest. For the ichthyologist, the list of retail trade names of fish and general English equivalents in Appendix B is especially useful. For example, the various categories of haddock are: very small = ping pongs, small = chats, medium = kit haddock, large = gibbers, and very large = jumbos; rockfish in England are members of the genus *Anarrhichas;* Norway haddock is *Sebastes marinus;* etc.

There are generalizations and ommissions—inevitable in a publication of this sort, which will annoy some. The fact remains that this publication should be on the shelves of fishery biologists in this country for reference and recommendation.—DANIEL MERRIMAN, *Bingham Oceanographic Laboratory, Yale University, New Haven, Connecticut.*

FISHING IN TROUBLED WATERS. By W. M. Chapman; J. B. Lippincott Co., Philadelphia, Pa., 1949: pp. 1–256. $3.00.—This interesting book is a popularly written narrative of a scientist turned fisherman by the necessities of World War II, who plys his trade in the tropics. The story is confined to those events that happened in the Solomon Islands from April through September, 1944. Dr. Chapman's trials and tribulations were those of many civilians that worked with the armed forces. Those few officers who really tried to help him kept his spirit up, while living on the small fishing schooner, *Crystal Star,* with Harlan Cheyne, three GI's and five Melanesians. The book elaborates on the intimate relations among these men, their personalities, psychological stresses of confinement on a small boat, their adventures with sharks, storms, crocodiles, dysentery, fights and discouraging technical difficulties. There is woven into the narrative descriptions of the habits of fishes and of other animals that abound on the gorgeous coral reefs. I thoroughly enjoyed the book.—LEONARD P. SCHULTZ, *U.S. National Museum, Washington, D.C.*

EAST OF THE ANDES AND WEST OF NOWHERE A NATURALIST'S WIFE IN COLOMBIA. By Nancy Bell Bates. Charles Scribner's Sons, New York, 1947: 237, 48 halftone plates, $3.50. —Books by naturalists' wives are all-too-few, perhaps because only the most fortunate of naturalists have had the privilege of having their wives accompany them on foreign expeditions or to tropical stations. I have thought of compiling a list of such books by wives to supplement a projected list of books by woman explorers and woman naturalists, especially as the latter category seems to be healthily increasing. My list would currently be headed by Mrs. Bates' book, perhaps with Mrs. Forbes' *Insulinde* next.

East of the Andes and West of Nowhere is the account of the Rockefeller Foundation Laboratory maintained in co-operation with the government of Colombia at Villavicencio, where the foothills of the eastern Andes meet the plains of the upper Orinocan Llanos. The purpose for which it was established was the study of insect-borne disease, especially jungle yellow fever and malaria. The life of the laboratory, of the town, and of the frontier cattle country stretching away to the east is portrayed in a vivid, appreciative, and warm-hearted report. One of the merits of this report is the portrait of Marston Bates, the director of the laboratory, that emerges from the intelligent and intelligible account of his work; and not the least of its merits is the unobtrusive portrait of its author. Mrs. Bates' direct and unornamented narrative writing, with flashes of wit and of humorous insight, seems to me to approach perfection as written English adapted to its purpose, or perhaps rather, to its accomplishment.

What makes a popular account of the Villavicencio laboratory not only interesting but important to the thoughtful biological reader is its demonstration of the importance

of the tropical field station, whether equipped for special problems or not, as essential to a new attack on all the problems of tropical biology. 'Museum Expeditions' have many objectives, some of them legitimate. All too frequently their objectives in the past have been to skim a cream of 'new species' from a region or to obtain first sight of some novel phenomenon rather than insight into its meaning. Such aims belong to a past time of museum rivalry, and not to what I envisage as the future era of co-operation when scientists will undertake the team work required for the patient and laborious disentangling of the tangled elements of the still new synthetic science of ecology. Tagging a mountain top is no more than a more expensive game of tag, and at an only slightly more adult level. Describing a harvest of new species no longer seems important unless the meaning of their presence and diversity and something of their interrelations with their environment are also discerned. Indeed, as an aside, the game of naming (with scientific names), by being itself so fascinating, and, with its armature of scholarship, so much an adult game, seems to me to have been harmful to the progress of biology. The funds spent by museums and museum patrons on so-called 'Expeditions' would amply support a series of permanent or semi-permanent stations. To establish them would require a willingness to co-operate and a capacity for co-operation that I discern much too rarely in my colleagues.

To come back to the book in hand, the reader is urged to buy a copy or borrow it from the nearest library; he will find in it an unusual account of a scientific endeavor and a portrait of a family in which two countries may take pride.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago, Illinois.*

HIGH JUNGLE. By William Beebe. Duell, Sloan and Pearce, New York, 1949: xii + 379 pp. illus. $4.50.—The systematic zoologist who looks beyond the game of nomenclature becomes involved in the evolutionary meaning of the categories he distinguishes and thus must look to the meaning of the characters by which he distinguishes his species and subspecies or higher groups. It is at once evident that many of the higher categories, especially the families (for example of snakes) are characterized by structures so evidently useful to the life of their animals that the existence of the group (family, order, or whatever) is adequately explained by adaptive radiation following the original acquisition of the adaptive character. Hence the branching and rebranching of the evolutionary tree; hence its numerous horizontal limbs; and hence the almost infinite variety of living organisms, as they diverge from the same level or attain a higher degree of complexity or efficiency and diverge again.. The interrelations of this wealth of forms of life challenge the naturalist to gain insight into the chains of cause and effect and into the correlations of the elements in this continuum of nature.

It is the merit of William Beebe's books, whether on the life of the sea or of the tropical forest, that the reader is made vividly conscious of some portions of the web of life and has demonstrated for him that it is indeed an interlocking web. *High Jungle* tells the story of successive visits to a unique tropical situation—the cloud forest on the slope of the Venezuelan Andes, where the existence of an abandoned unfinished hotel, "Rancho Grande," provided the base for the party of naturalists who accompanied Mr. Beebe or who visited him. How much needed an effective shelter is in the cloud forest only those who have lived in the spell of its chill fogs are likely to know.

There are high-lights for the herpetologist in the present book, of which the outstanding one is the account with photographs of the birth of froglets from the pouch on the back of a marsupial frog (*Gastrotheca ovifera*). Two papers on the fishes of Rancho Grande and five including notes on the reptiles of that station are listed in the appendix. Most gratifying of single items of information is the account of the fighting of the male rhinoceros beetles. These beetles, whose spectacular horns make them one of the longest of their vast order, if not the bulkiest, had been known to entomologists for two centuries before there was any real certainty as to the use of the horns. The demonstration that they are used in combat between males and even on occasion to carry off a female, leaves a multitude of unanswered questions.

High Jungle is one of the most interesting of William Beebe's books, with a wealth of observation and illustration; it forms a supplement and contrast to his earlier accounts of the lowland rain-forest of British Guiana.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago, Illinois.*

EDITORIAL NOTES AND NEWS

Summary of the 1949 Meeting

THE twenty-ninth annual meeting of the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS was held at Washington, D. C., June 19 to 21, 1949.

Activities of June 19

A LARGE group of members and friends of the Society met at the United States National Museum at 11 A.M., Sunday, June 19. They were transported by personal cars to Plummer's Island on the Potomac River, where they were the guests of the WASHINGTON BIOLOGISTS FIELD CLUB. MORRIS K. BRADY was in charge and provided a delicious picnic lunch and other refreshments. E. P. KILLIP, a member of the Washington Biologists Field Club, conducted an interesting tour of the island for about 70 members in attendance.

Governors' Meeting

THE Board of Governors' meeting held in the Willard Hotel was called to order by PRESIDENT NETTING at 8:30 P.M. with 20 governors present. The reading of the 1948 minutes was dispensed with inasmuch as they had already been published in COPEIA. The 190 new members added to the Society since the New Orleans meeting, March 23, 1948, were formally elected to membership. Six members of the Board of Governors, namely CHARLES M. BOGERT, ROLF L. BOLIN, FRANCES N. CLARK, H. K. GLOYD, WALTER L. NECKER, and MARGARET STOREY, whose term of office had expired, were re-elected to serve until 1954. In addition, the following new members were elected to the Board of Governors to serve for a five-year period: N. B. GREEN, RAYMOND E. JOHNSON, ERNEST A. LACHNER, and LUIS R. RIVAS. No vacancies were reported in the honorary foreign membership but several foreign ichthyologists and herpetologists were mentioned as possible candidates for future openings. The Secretary reported that the Society had 37 fully paid and 7 partly paid life members.

TREASURER HENN reported a total of $4,244.24 in the Endowment Fund and that $4000 of this amount is invested in Series E United States Savings Bonds. It was decided that the interest from this fund continue to be added to the principal. The Special Gift Fund totaled $2975. Two grants totalling $250 have been made from the Revolving Research Fund during the year leaving a balance in this fund of $1265.25. A general discussion of this fund followed but no action was taken. The chairman of the Revolving Research Fund Committee, FREDERIC H. STOYE, will be asked to report on the results obtained at the next annual meeting. The treasurer was empowered to send fifty pounds as a gift from the Society toward the cost of the 1948 Zoological Record.

GEORGE S. MYERS reported briefly on the Inter-American Conference on Conservation of Renewable Natural Resources held at Denver, Colorado, September 7-20, 1948. VICE-PRESIDENT TRAUTMAN reported at some length on methods of making membership drives and suggested that the least expensive and most effective way to get new members is through present members and commended the newly established practice of sending application-for-membership forms to members at the time annual due bills are sent. The usual methods employed in general drives are expensive, and there is a very high turnover in membership so obtained. It was decided that the Society shall not publish a list of the total membership of the Society but shall publish a list of the new members in Copeia 1949 (4).

A long discussion of the American Institute of Biological Sciences, of which our society is a constituent member, ended with a resolution that KARL P. SCHMIDT, our representative on the governing board of the Institute, make a report on the results obtained by the A.I.B.S. during the first year of operation. This information is to be sent to the members of the Board of Governors.

It was recommended that the society meet at Salt Lake City, Utah, during the

period June 19-24, 1950, in response to an invitation from the Western Division of the Society, the Executive Committee of the Pacific Division of the A.A.A.S., and the Department of Zoology, University of Utah, tendered through CARL L. HUBBS.

Upon a suggestion by LEONARD P. SCHULTZ it was decided to make a regular number of a future issue of COPEIA a memorial number honoring DR. SAMUEL F. HILDEBRAND. ROBERT R. MILLER is to assist the editors in the preparation of this number. No additional space is authorized unless funds are forthcoming from other than regular society sources.

A discussion of reprint and publication costs of COPEIA was held. ROBERT R. MILLER presented considerable information on the costs of reprints in other societies, and further volunteered to obtain information on printing costs from other publishers for a future report to the Society. PRESIDENT NETTING announced that the Ann Arbor Press has reduced reprint costs approximately 15 per cent, effective COPEIA, 1949 (2).

A resolution was passed for later action at the business meeting that Article 4 of the By-laws are amended to change the title of the Assistant Secretary to Publications Secretary.

Activities of June 20

PRESIDENT NETTING called the annual business meeting to order at 10:30 A.M. in the auditorium of the United States National Museum. The minutes of the 1948 meeting, previously published in COPEIA, were not read.

The SECRETARY reported that 190 members were obtained since the last meeting, 37 members resigned, 51 members were dropped for non-payment of dues, and 2 members died. The losses totaled 90, resulting in a net gain of 100, and making a total membership of 919 members, a new high for the Society. Forty-two new subscriptions were obtained and 4 were discontinued, the net gain being 38, and the total number of subscribers now stands at 269. The combined total of members and subscribers as of June 18, 1949, was 1188. Geographical tabulations indicated that 246 copies of COPEIA go to 37 foreign countries; Russia leads with 55, followed by Canada with 47, and England with 17. Domestic copies total 942; California leads with 142, followed by New York with 115, Michigan with 66, Illinois with 52, Pennsylvania with 50 and Texas with 44. Delaware is the only state not represented either by a member or a subscriber. Fourteen hundred copies of COPEIA are being printed in 1949, an increase of 100 over last year.

TREASURER HENN reported as follows for the calendar year of 1948: Receipts; dues received, $3333.82; subscriptions received, $1374.80; reprints paid for, $1009.94; back numbers of COPEIA sold, $718.84; monies contributed to be awarded for prizes, $120.00; miscellaneous receipts, $2.75; total receipts for 1948, $6560.15. Expenditures: costs of publication of COPEIA, $3800.57; reprints costs of COPEIA (these monies will be returned to the Society by the authors), $949.75; photolithographing of scarce issues of COPEIA, $160.35; printing of stationery, due bills, reprint schedules, etc., $177.93; stenographic services chiefly in sending out and tabulating due bills, $103.50; postage $211.91; expenses of the 1948 annual meeting in New Orleans including prizes awarded, $276.00; expenditures applicable to the Western Division, $105.00; miscellaneous expenses or transfers of funds, $43.65; office equipment for secretary, $81.25; expenses of membership drive, $23.70; purchase of back issues of COPEIA from member, $6.00. Total expenditures, $5939.61. The excess of receipts over expenditures, $620.54. As of June 10, 1949, there was a total of $7664.55 in the checking account of the Society. However, it was pointed out by the treasurer that the A.I.B.S. had not yet tendered its bill. The Society is billed at the rate of $1 per member for a member who does not belong to any other constituent society of the A.I.B.S. In case of duplicate membership the Society is billed for fifty cents. The TREASURER also reported on the Revolving Research Fund and the Endowment Fund (the amounts in the two funds were reported above). The SECRETARY summarized the actions taken at the Board of Governors' meeting.

In accordance with a recommendation made at the 1947 meeting PREISDENT NETTING appointed in advance as *a Nominating Committee* CHARLES A. WALKER, Chairman, E. R. DUNN, ERNEST A. LACHNER, and REEVE M. BAILEY. This committee presented its report. There were no nominations from the floor. PRESIDENT NETTING asked E. R.

DUNN to take the chair and the Secretary was instructed to cast a ballot for the slate recommended by the *Nominating Committee*. The following officers were therefore duly elected: JOHN TREADWELL NICHOLS and HELEN T. GAIGE, *Honorary Presidents;* M. GRAHAM NETTING, *President;* GEORGE S. MYERS, F. H. STOYE and FRED R. CAGLE, *Vice-Presidents;* EDWARD C. RANEY, *Secretary;* LIONEL A. WALFORD, *Publications Secretary;* DWIGHT A. WEBSTER, *Treasurer* (to take over at the end of the fiscal year, December 30, 1949); HELEN T. GAIGE, *Editor-in-Chief;* GERALD P. COOPER, *Ichthyological Editor;* KARL P. SCHMIDT, *Herpetological Editor;* ROLF L. BOLIN, E. R. DUNN, NORMAN HARTWEG, RAYMOND JOHNSON and ROBERT R. MILLER, *Editorial Board;* WALTER L. NECKER, *Historian.*

Concurring with the action of the Board of Governors the Society voted to amend article 4 of the By-laws to change the title of Assistant Secretary to Publications Secretary. The Society voted as favoring the admission of the Society of General Physiologists to membership in the A.I.B.S. PRESIDENT NETTING appointed a *Prize Award Committee* of the following: ALBERT H. WRIGHT, ROBERT R. MILLER, GERALD P. COOPER, and JOSEPH R. BAILEY and a *Resolutions Committee* of LESTER R. ARONSON, JAMES A. FOWLER, and HERNDON G. DOWLING, JR.

DR. H. R. CRUIKSHANK, Assistant Executive Secretary, of the American Institute of Biological Sciences, gave a rather full report on the workings of this organization. The A.I.B.S. was started in February 1948 and now consists of 15 member societies, each of which elects a member of the Governing Board. These member societies are assessed at one dollar per member or fifty cents per member if an individual belongs to more than one member society. However, $1000 is the maximum that any one society contributes per year. Two affiliate societies contribute $100 each. The names of the affiliate societies are included on the letterhead but have no member on the Governing Board of the A.I.B.S. The Society of General Physiologists has also applied for membership. The A.I.B.S. has laid down the principle that all projects that are started under its cognizance must be self-supporting. A Handbook of Biological Data is now being compiled under the leadership of the A.I.B.S. and the first volume is due to be published in the fall of 1949. Members of our Society are asked to contribute, in tabular form, material of biological importance to be included in this Handbook of Biological Data. Data on all phases of ichthyology and herpetology are desired. The A.I.B.S. is also acting as an advisor in regard to the Selective Service Act and serves on a committee that advises the U. S. Army on the use of biologists and biology. The A.I.B.S. is also to act for the Office of Naval Research in assisting the screening of new research projects. A publications problem committee has been active and a report is expected within a short time. Aside from attempting to reduce the costs of publications by some standardization, they are considering setting up an editorial office for routine checking of manuscripts after acceptance by the editors of the constituent societies. An address system is now being set up which may be used at any time by any of the constituent societies merely for the cost of postage. A mimeographed News Letter has been published on a moderate scale, during the past year, but it is planned to later send this to all members of constituent societies. The meeting adjourned at 12:15 P.M.

At 12:30 P.M. a group photograph was taken on the steps of the main entrance to the U. S. National Museum with WILLIAM F. CARBINE in charge. Copies may be obtained for $1.25 from Guild Photographers, 915 19th St. N.W., Washington, D.C.

The afternoon session convened at 2:00 P.M. in the auditorium of the U. S. National Museum with JOHN L. KASK presiding. The following papers were read:

1. **Ovulation in the mouthbreeding cichlid fish, *Tilapia macrocephala* (Bleeker).—Lester R. Aronson and A. Marie Holz-Tucker.**
2. **Color pattern inheritance in the genus *Eleutherodactylus*.—Coleman J. Goin.**
3. **The delimitation of genera in North American fresh-water fishes.—Reeve M. Bailey.**
4. **Distributional and adaptational phenomena in *Aristelliger*.—Max K. Hecht.**
5. **Brackish marsh fishes from the gulf coast of Florida.—John D. Kilby.**
6. **The mutual affinities of the three orders of living amphibians.—E. R. Dunn.**
7. **Results of a survey of the fresh-water fish fauna of the Dominican Republic.— Luis R. Rivas.**

7a. **Description of ammocoetes of three Quebec lampreys.—V. D. Vladykov.**

ANNUAL SMOKER

Approximately 150 members and guests gathered at 8 P.M., June 20, at the Reptile

House in the National Zoological Park for the Annual Smoker. Liquid refreshments were provided and a fine social time was enjoyed by all. WILBERT M. CHAPMAN was in charge.

Sessions on June 21

BECAUSE of the large number of papers to be read split sessions were held on the morning of Tuesday, June 21. The herpetological session was held in room 43, U. S. National Museum with M. K. BRADY presiding and the following papers were read.

8. The distribution of *Desmognathus* in the southern states.—Arnold B. Grobman.
9. Variation in *Chrysemys picta bellii* Gray, the western painted turtle.—Norman Hartweg.
10. A preliminary survey of the North American forms of the genus *Elaphe*.—Herndon G. Dowling.
11. Notes on the natural history of the spadefoot toad in Florida.—William M. Beck, Jr.
12. Distribution of herpetofauna on Edward's Ranch, Tarrant County, Texas.—John W. Forsyth and L. W. Ramsey.
13. Island-hopping frogs and East Indian zoogeography.—George S. Myers.
14. A population and home range study of the box turtle.—Lucille F. Stickel.

In the auditorium of the U. S. National Museum, chairman STILLMAN WRIGHT called the ichthyological session to order at 9:30 A.M. and the following papers were read:

15. An experimental study of the sex ratio in fish.—Herbert B. Saslow.
16. Recent developments of fishery research in Oklahoma.—Carl D. Riggs.
17. Comparison of percentage returns of marked trout in two West Virginia streams.—E. A. Seaman, P. E. Swasey, and R. F. Stephens.
18. Temperature and size in marine fishes on the Atlantic and Gulf coasts.—Gordon Gunter (by title only).
19. The food of the black crappie, *Pomoxis nigro-maculatus* (LeSueur), in Orange Lake Florida.—George K. Reid, Jr.
20. Fish collecting in the Persian Gulf and Red Sea.—Donald S. Erdman.

A collection of $73.43 was taken at the end of the morning sessions to be used to send parcels to needy colleagues in foreign countries. Other contributions may be sent to DORIS COCHRAN, U. S. National Museum, who continues to administer this fund.

The afternoon sessions convened in the auditorium of the U. S. National Museum at 2 P.M. with MILTON B. TRAUTMAN presiding.

21. Fresh-water fishes and East Indian zoogeography.—George E. Myers.
22. Herpetological activity in southern Central America.—E. R. Dunn.
23. Courtship of *Eumeces egregius* at Key West, Florida, March 13, 1946.—Lewis H. Babbitt.
24. A study of the reptiles and amphibians, in a burned over area, Dade County, Florida, as a measure toward future conservation.—Lewis H. Babbitt.
25. The biology of Arnhem Land, Northern Australia.—Robert R. Miller.
26. Fishing in the Far East.—John L. Kask.

An attractive exhibit by ALBERT H. WRIGHT entitled "American Snake Stores—Source Book and Working Range Maps of the Snakes of U. S. A. and Canada," was set up in the hallway opposite the auditorium.

The annual banquet was held on June 21 at 7:30 P.M. at the Collingwood Restaurant near Mt. Vernon, Virginia, with WILLIAM STICKEL in charge. WILLIAM M. MANN, Director of the National Zoological Park, acted as toastmaster. He introduced DR. ROBERT MERTENS, honorary foreign member from Frankfurt, Germany. The annual prize award of $25 for the best paper to be given by a non-professional member was presented to HERNDON G. DOWLING, JR. for his paper "A preliminary survey of the North American forms of the genus *Elaphe*." The presidential address, entitled "Scientific Museum Administration," was given by M. GRAHAM NETTING. Candid color moving pictures taken on the field trips at the New Orleans meeting by MR. and MRS. LEWIS H. BABBITT were shown. The meeting ended with the report of the *Resolutions committee*.

Whereas, the 29th Annual Meeting of the American Society of Ichthyologists and Herpetologists, held at the United States National Museum, Washington, D.C. from June 19 through June 21, 1949, has been successfully completed:

Therefore, be it resolved: (1) That the members of the American Society of Ichthyologists and Herpetologists express their sincere appreciation for the hospitality extended to them by the *Local Committee*: L. P. SCHULTZ (chairman); M. K. BRADY, W. F. CARBINE, W. M. CHAPMAN, DORIS COCHRAN, D. H. DUNKLE, D. S. ERDMAN, I. GINSBURG, J. L. KASK, E. A. LACHNER, R. A. LITTLEFORD, W. G. LYNN, W. M. MANN, R. MANSUETTI, W. H. STICKEL, R. SILLIMAN, and L. A. WALFORD. (2) That we are especially indebted to DR. ALEXANDER WETMORE, Secretary of the Smithsonian Institution, and REMINGTON KELLOGG, Director of the U. S. National Museum, for the use of the

many facilities of the U. S. National Museum, and for the efforts of many members of the Museum staff in contributing to the success of the meetings. (3) That we thank WILLIAM M. MANN, Director of the National Zoological Park, and his staff for their courtesy in extending to us the use of the Reptile House for the Annual Smoker. (4) That we are likewise appreciative of the fine time shown the members of the Society of the WASHINGTON BIOLOGISTS FIELD CLUB ON THE occasion of the very enjoyable field trip to Plummer's Island and especially to MR. and MRS. MAURICE K. BRADY and others for organizing the trip and providing the refreshments and to E. P. KILLIP, Head Curator, Department of Botany, U. S. National Museum, for a very interesting and instructive tour of the island. (5) That thanks are due to MRS. WILLIAM M. MANN and MRS. M. K. BRADY for entertaining the ladies.

A total of 103 members registered and paid a $1.00 fee which was assessed to cover the cost of the Annual Smoker and part of the other expenses of the local committee.—EDWARD C. RANEY, *Secretary*.

Atlantic Fisheries Biologists

THE ATLANTIC FISHERIES BIOLOGISTS held their annual meeting at Woods Hole, Mass., on September 16-18, 1949. This organization is composed of professional fisheries biologists engaged in the investigation of problems in fisheries in both fresh and salt water. About 45 members gathered at the U. S. Fishery Research Laboratory for the three-day discussions. These members represented the following organizations: U. S. Fish and Wildlife Service, Fisheries Research Board of Canada, Maine Department of Sea and Shore Fisheries, Maine Department of Inland Fish and Game, New Hampshire Fish and Game Department, Massachusetts Division of Fisheries and Game, Connecticut State Board of Fisheries and Game, New York State Conservation Department, University of New Brunswick, University of Maine, University of New Hampshire, Springfield College, Harvard, University of Rochester, Woods Hole Oceanographic Institution, and Massachusetts Fish and Game Association.

Several general discussion groups were held at which the broad aspects of the subjects were discussed. DANA E. WALLACE opened the debate on the status of clam research on the Atlantic Coast. The work of the Fish and Wildlife Service, the Fisheries Research Board of Canada, the various States, and the Woods Hole Oceanographic Institution on clams and quahogs was reviewed.

A discussion of the new tools and techniques used in fisheries research was opened by A. H. LEIM of Canada. Various investigators described much of the new equipment developed during and after the war. Methods for tagging fish to study migrations were described.

The discussion on "The Responsibilities of the Biologist Towards Improving Fisheries" was lead by R. REED LOGIE of Canada. The various attitudes of individuals employed by the States, the Federal Government, and private organizations toward the formulation of laws and regulations as the result of research were discussed.

The last conference dealt with the "Control of Fish Populations in Ponds" and was directed by C. FLOYD JACKSON of New Hampshire. The use of poisons, fishing laws, and predatory species to control the number of undesirable fish in lakes and ponds was debated.

WILLIAM R. MARTIN and FRANK D. MCCRACKEN of the Fisheries Research Board of Canada, St. Andrews, New Brunswick, were elected *President* and *Secretary-Treasurer* for the coming year to succeed HOWARD A. SCHUCK and LOUIS D. STRINGER of the U. S. Fish and Wildlife Service, Woods Hole, Mass. The members visited the U. S. Fishery Research Laboratory, the Marine Biological Laboratory, and the Woods Hole Oceanographic Institution. At these places the physical facilities and the specific research problems were examined.—LOUIS D. STRINGER, *Secretary-Treasurer*.

Aid to Copeia

THE editors acknowledge with gratitude contributions toward the cost of the collotype plates in this issue from the NEW YORK ZOOLOGICAL SOCIETY.

Indo-Pacific Fisheries Council

THE Conference of the FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO), which is made up of the delegates from its 58 member governments, in keeping with the basic aims of the Organization of "raising levels of nutrition and standards of living" and "securing improvements in the efficiency of the production and distribution of all food and agricultural products," passed the following recommendation at their 1947 meeting held in Geneva, Switzerland:

that FAO should take action to initiate the formation of regional councils for the exploration of the sea in parts of the world not now actively served by similar bodies.

Approximately one-half of the world's people live in South East Asia, and fish forms an important part of their staple diet. Because the fisheries are in a very primitive state of development, the Director-General of FAO decided to start organization of fisheries councils in this area.

The organizational meeting for this Indo-Pacific Fisheries Council, as it is called, was held in Baguio, Republic of the Philippines, in February, 1948. Here an agreement was drawn up and submitted to the interested governments for approval. The Council came into force on November 9 when the fifth government submitted its acceptance of the Agreement. The inaugural meeting of the Council was called for March 24, 1949, and was held in Singapore. At this meeting DR. BAINI PRASHAD, of India, was elected Chairman and DR. J. D. F. HARDENBERG, of the Netherlands, Vice-chairman. The FAO Regional Fisheries Officer for South East Asia acts as Permanent Secretary.

At the time of the inaugural meeting eleven countries, Australia, Burma, Ceylon, China, France, India, the Netherlands, Republic of the Philippines, Siam (Thailand), United Kingdom and the United States of America, had formally joined the Council, and Pakistan has indicated her intention to join. Any member country of FAO can join by indicating its acceptance of the Baguio Agreement. Provision is made for countries not members of FAO to join as well, but this is contingent upon the approval of the Council and the FAO Conference and upon the countries assumption of a proportionable share of the expenses of the secretariat.

According to the Agreement the functions and duties of the Council to be carried out in the Indo-Pacific area are as follows:

1. to formulate the oceanographical, biological and other technical aspects of the problems of development and proper utilization of living aquatic resources;
2. to encourage and co-ordinate research and application of improved methods in every day practice;
3. to assemble, publish or otherwise disseminate oceanographical, biological and other technical information relating to living aquatic resources;
4. to recommend to member governments such national or co-operative research and development projects as may appear necessary or desirable to fill gaps in such knowledge;
5. to undertake, where appropriate, co-operative research and development projects directed to this end;
6. to propose, and where necessary to adopt, measures to bring about the standardization of scientific equipment, techniques and nomenclature;
7. to extend its good offices in assisting member governments to secure essential materials and equipment;
8. to report upon such questions relating to oceanographical, biological and other technical problems as may be recommended to it by member governments or by FAO and other international, national or private organizations, with related interests;
9. to report annually to the FAO Conference upon its activities, for the information of the Conference; and to make such other reports to FAO on matters falling within the competence of the Council as may seem to it necessary and desirable.

Each member government will be represented at meetings of the Council by a single delegate, who may be accompanied by an alternate and by experts and advisers. The officers of the Council consist of a Chairman, Vice-chairman and a Secretary. The Chairman and Vice-chairman are elected from among the delegates or alternate delegates. The Secretary is the FAO Regional Fisheries Officer. The Chairman, the Vice-chairman and the Secretary together constitute the Executive Council which is empowered to

carry out the executive functions of the Council between formal meetings. Two Standing Technical Committees are provided, (1) a Committee on biology and hydrology and (2) a Committee on technology. Each Technical Committee has an elected chairman and rapporteur. It is the function of each Committee in its own carefully defined field to plan technical activities for the approval of the Council and to see that activities approved by the Council are carried out.

The member governments will pay the expenses of delegates and their alternates, experts and advisers, occasioned by attendance at meetings of the Council. The expenses of the secretariat, including publications and communications, and of the Chairman and Vice-chairman when performing duties connected with its work during intervals between meetings will be paid by FAO, in accordance with rulings approved by the FAO Conference. The expense of research or development projects undertaken by individual members of the Council, whether independently or upon the recommendation of the Council, shall be paid by the respective governments. The expenses incurred in connection with co-operative research or development projects undertaken by governments, shall be paid by the participating governments in the proportion to which they shall mutually agree.

The Chairman will call a meeting of the Council at least once a year unless directed otherwise by a majority of the member governments. The seat of the Council is at the regional headquarters of FAO which is at present in Bangkok, Thailand.

In addition to the purely organizational aspects of the inaugural meeting, twenty-one scientific papers were read on subjects in the field of fisheries biology, fisheries technology, on hydrography and the socio-economic aspects of fisheries. Four additional papers were presented at symposia on the general subject of pelagic fisheries. The symposium papers and probably some of the others will be published in the proceedings of the Council.

As the Council is a scientific and technical organization, it seems fitting that member governments should send technical men as their delegates to Council meetings. That governments kept the faith is amply testified by the delegations that were sent to this inaugural meeting. Australia's delegate was DR. HAROLD THOMPSON, Chief of the Division of Fisheries in Australia's Council for Scientific and Industrial Research; Ceylon was represented by DR. C. AMIRTHALINGAM, Director of Ceylon's fisheries; France was represented by M. LEMASSON and M. DURAND, Chief of the Fisheries Service and Assistant in the Oceanographic Institute of French Indo-China respectively; India was represented by DR. BAINI PRASHAD, Fisheries Development Officer in the Government of India, who was elected the first Chairman of the Council, and DR. N. K. PANIKKAR, General Physiologist, Central Marine Fisheries Station, Madras; the Netherlands delegation was made up of DR. J. K. de JONG, Head of the Sea Fisheries, Batavia, DR. J. D. F. HARDENBERG, Head of the Laboratory for the Investigation of the Sea, Batavia, elected Vice-chairman of the Council, W. H. SCHUSTER, Inland Fisheries, COMDR. H. R. KRAUSS, Hydrographer, Department of Navigation, Batavia, and P. W. LOKOLLO, Fisheries Adviser for East Indonesia; the Republic of the Philippines sent DR. CLARO MARTIN, Chief, Division of Fisheries Technology, Manila; the United Kingdom's delegation included DR. W. M. CLYDE, Director of Economic Activities, Office of the Commisioner-General for U.K. in South East Asia, DR. H. W. JACK, Agriculture Officer from the same office and several Colonial Fisheries Officers, including T. W. BURDON, from Malaya and Singapore, as well as THAM A. KOW and SOONG-MING KONG, biologists attached to his office, E. BANKS from Sarawak, J. A. TUBB, from North Borneo, S. Y. LIN and J. CATER, from Hong Kong, and E. H. WEIGALL, from Brunei. The United States delegates included MR. O. E. SETTE, of the Fish and Wildlife Service's Pacific Oceanic Fisheries Investigations, DR. W. E. S. FLORY, of the Department of State, DR. H. J. DEASON, Office of Foreign Activities, Fish and Wildlife Service, CHARLES BUTLER, of Pacific Oceanic Fisheries Investigations, and HERBERT WARFEL, of the Service's Philippine program. Besides the delegates there were present as observers, W. C. HERRINGTON, from SCAP, CHYUNG MOON GI, Head of the Fisheries School in Korea, and DR. A. WOLSKY, of Unesco. Such a delegation leaves little to be desired and augurs well for the success of the Council.—J. L. KASK, *FAO Fisheries Division, 1201 Connecticut Ave., N.W., Washington 6, D.C.*

ADI

THE AMERICAN DOCUMENTATION INSTITUTE, 1719 N Street, Washington, D.C., organized in 1937 as a non-profit corporation, has circulated again an advertisement and announcement of the service which it provides to authors and to societies and journals in handling manuscripts which are too long, or too detailed, to be accommodated in current journals or other outlets of publication. If the author and editor agree, the complete document including all types of illustrations, in finished form, is transmitted through the editorial staff of a journal to the ADI for permanent deposit there. The document is assigned an ADI number. The usual type of abstract or summary presentation of the material can be published in the particular journal, together with a footnote reference to the ADI reference number for the complete document along with information on cost of copy of the complete document. The Institute provides copy of documents on 35-mm. microfilm at 1c a page, or photocopies 6" x 8" readable without optical aid at 10c a page, with a minimum charge of 50c per document. There is no initial charge to journal or author for deposition of the document with ADI. Something over 2000 documents are now on file with the Institute, for which a catalogue is available free of charge. The editors of COPEIA will welcome the opinions of its contributors as to the extent to which the ADI might be useful.

Newfoundland Biological Station

FISHERIES research in Newfoundland is now being carried on under the FISHERIES RESEARCH BOARD OF CANADA. The name of the former Newfoundland Laboratory has been changed to that of the NEWFOUNDLAND BIOLOGICAL STATION: this station will in future carry on work in marine biology and hydrography only. Publication in the future will be through the Journal, Bulletins and other channels of the Fisheries Research Board of Canada.

The new laboratory wishes to be continued on all exchange lists for fisheries publications. The address on such exchange lists should be changed from the Newfoundland Government Laboratory, Government Laboratory, or Fisheries Research Institute, St. John's, to the Newfoundland Biological Station, St. John's, Newfoundland.—WILFRED TEMPLEMAN, *Director*.

Suggestion to Graduate Students

THE editors suggest that students who have been admitted as doctoral applicants in their respective graduate schools and have definitely started work on a doctoral problem in ichthyology or herpetology, register this information through the medium of COPEIA. With the very large number of doctoral students now working in the two fields, the possibility of duplication, with its attendant heartaches, is a very real one. Such an announcement will have more than a mere protective value, especially for students in systematics. Persons in charge of the smaller collections, both institutional and private, will be thus informed, and will often, no doubt, be able to supply valuable materials and information which would otherwise be unused.

Doctoral Work in Herpetology in Progress at the Univ. of Mich.

DOCTORAL students working on herpetological subjects at the University of Michigan are as follows: GEORGE BAXTER, on an ecological study of the vertical distribution of certain salientia in Wyoming; CHARLES CARPENTER, on the habitat selection and ecological relationships of three local gartersnakes, *Thamnophis butleri, T. sirtalis sirtalis* and *T. ordinatus ordinatus;* DAVID DELZELL, on an ecological study of the activity of *Hyla crucifer;* HERNDON DOWLING, on a systematic revision of the genus *Elaphe*; T. P. HAINES, on an osteological study of snake skulls, with especial reference to the natricines; RODGERS D. HAMILTON, on the ecology and distribution of the Alaskan woodfrog; EMANUEL HERTZLER, on color pattern determination in *Plethodon cinereus;* BERNARD MARTOFF, on population dynamics of local populations of the genus *Rana;* ARCHIE SHARER, on visual perception in certain snakes. Although working in several different units, all the doctoral students may be reached through the Department of Zoology.

News Notes

DR. SUNDER LAL HORA, noted Indian ichthyologist, who is Director of the Zoological Survey of India and Honorary Foreign Member of the ASIH, was in the United States from August 12 to November 1, as a delegate to the FAO Section of the United Nations conference. Dr. Hora visited centers of zoological, fishery and oceanographic research, and gave 29 lectures on the fishery biology, ichthyology, and ecology and zoogeography of the fishes of India and southeast Asia.

SIDNEY SHAPIRO has recently returned from several years overseas, where he worked primarily on the tunas of the Pacific region—first in Japan with the Fish Division, Natural Resources Section, SCAP, and then with the Pacific Oceanic Fishery Investigation, of the Fish and Wildlife Service, at Honolulu, T. H. He is now assigned to the Branch of Commercial Fisheries, U. S. Fish and Wildlife Service, Washington 25, D.C.

DR. JOHN VAN OOSTEN has resigned as Chief of the Great Lakes Fishery Investigations to accept a full time research position with the U. S. Fish and Wildlife Service. He will remain in his same offices at the University of Michigan and will act in an advisory capacity in matters affecting the Great Lakes fisheries.

DR. WILMER TANNER has joined the zoology staff at Brigham Young University, Provo, Utah.

DR. CLARENCE M. TARZWELL, as Chief of the Biology Section of the Federal Public Health Service, is engaged in environmental health and water pollution studies. He is stationed at the Environmental Health Center, 1014 Broadway, Cincinnati 2, Ohio.

MR. A. FRASER-BRUNER, of the British Museum (Natural History), has recently returned from the Gulf of Aden. where he has been making a survey of the fishes. A report of this field work will be published by the Colonial Office, along with smaller papers dealing with special discoveries. One special study was a revision of the Red Sea species of hammerhead sharks. When he has finished his reports on the Gulf of Aden, Mr. Fraser-Bruner expects to go to East Africa, and later to other colonial territories, where he will give special attention to the sharks, tuna, and other large fishes.

ROSS ALLEN, Director of the Silver Springs, Florida, Reptile Institute, has announced the establishment of a museum, in which he expects to house a complete collection of southeastern reptiles and amphibians, and of a research division of the Institute. DR. WILFRED T. NEILL has resigned from the staff of the Biology Department of Augusta Junior College, Augusta, Georgia, to join the new research division. Mr. Allen and Dr. Neill will collaborate on the preparation for publication of their accumulated notes on the herpetological fauna of Florida and Georgia.

Turin Zoological Museum

THE ZOOLOGICAL MUSEUM OF TURIN (Italy) is being restored after the damages of the war: together with those of Genoa and Florence it is now one of the largest in this country. The collections of fishes and amphibians have been completely ordered and are fully available to the students; the same applies to crocodilians and lizards, but other reptiles are still badly in need of revision. A separate and rich collection of Italian amphibians and reptiles is in good order: a catalogue of it was published in 1942-43. Some recent facilities have permitted the saving of a number of very valuable specimens, but as a whole a lot of work and of funds are still needed. A great amount of herpetological material from different countries, including America, and chiefly assembled by the late DIRECTOR M. G. PERACCA, remains to be worked out. In Turin are preserved the types of about 70 forms of fishes (a list of which was published in 1940), 25 of amphibians and 60 of reptiles: special care has been devoted to them. Material from Panama, Ecuador, Brazil, Bolivia and Argentina will prove of particular interest for American students. Lists of the species and information may be obtained from PROF. ENRICO TORTONESE (Zoological Museum, Via Accademia Albertina 17, Torino, Italy), who has the collections under his care.

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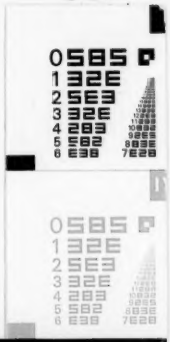
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